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**Boston Public Schools
Citywide Learning Standards
and
Curriculum Frameworks
Grades K-5**

**Version 96.1
June 28, 1996**

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The Boston Public Schools' Learning Standards and Curriculum Frameworks: **Goals and Guiding Principles**

Goals: The Boston Public Schools endorse the broad goals set forth in the Massachusetts Common Core of Learning. Our learning standards and curriculum frameworks are designed to produce classrooms where students are encouraged to:

- Think, Question, and Communicate
- Gain and Apply Knowledge
- Work and Contribute in Meaningful, Purposeful Ways

Students think, question, and communicate to make sense or meaning of their world and experiences. "Thinking includes being able to internalize new ideas and connect them to familiar concepts and prior knowledge." Questioning includes the framing of thoughtful questions, and the pursuit of these questions until the student fully understands. "Communicating means putting learning into the language of speech or writing, and requires reflection in such forms as examination, clarification, analysis, and synthesis."

Students gain and apply knowledge to pursue ideas and experiences, and apply this new knowledge in real life contexts. "This pursuit is interactive by nature. The more experiential it is, the more powerful the learning."

Students' work needs to be "meaningful and purposeful. The process and products of student work (need to be) valued contributions to the school and community. Imbedded in powerful learning experiences are notions of persistence, self-discipline, hard work and effort, and pride in producing quality work." (quotations from The Massachusetts Curriculum Framework, p. 6)

These goals frame the teaching, learning, and assessment process. They are critical to lifelong learning, and essential to gaining students' commitment to the learning process.

Guiding Principles: The following principles are intended to unite the members of the Boston Public Schools community. They extend our goals and provide guidelines for the continuous improvement of teaching and learning in our schools.

The Teaching/Learning Process in the Boston Public Schools:

- Engages all students in challenging, purposeful, and sustained work.
- Focuses on those skills and understandings of fundamental importance to students' success in and outside of school.
- Includes a variety of materials and strategies designed to bring out the best in every child.
- Emphasizes inquiry, problem-solving, discovery, and the real-world application of key concepts, principles, and lessons.
- Immerses students in the work, ideas, beliefs, experiences, and perspectives of people from a broad array of cultures and backgrounds.
- Is developmentally-appropriate.
- Points to the connections within and across disciplines.
- Uses assessment as an ongoing process to improve teaching and learning.
- Utilizes technology to the fullest, to enrich the learning process.
- Is nurtured by learning environments that are safe, disciplined, and focused on teaching and learning.

The Citywide Learning Standards and Curriculum Frameworks: Introduction

The Boston Public Schools Citywide Learning Standards describe what every student in the Boston Public Schools will know and be able to do, as a condition of promotion, course completion, and graduation.

The Curriculum Frameworks identify key products, tasks, and tests students will complete, and key questions they will answer, to demonstrate they have developed the knowledge and skills included in the Learning Standards.

In the Fall of 1995, the Boston Public School Committee and Superintendent Thomas Payzant responded to the emergence of new national and state-level standards, and the absence of clear expectations for Boston Public School students, by calling for the development of citywide learning standards, and curriculum frameworks, for the following core subjects:

- English Language Arts, Mathematics, Science, and Social Studies (to be developed during the 1995-96 academic year)
- World Languages (including English as a Second Language and Native Languages of our target bilingual populations), Health, Physical Education, and the Arts (to be developed in 1996-97)

Over the course of the past six months, the enclosed standards and frameworks have been developed for English Language Arts, Mathematics, Science, and Social Studies. The standards identify what students will know and be able to do as a condition of promotion, course completion, and graduation. The frameworks identify additional objectives; key products, tasks, and tests students will complete; and key questions they will answer, to demonstrate they have developed the knowledge and skills included in the standards.

The standards and frameworks are closely aligned with the Massachusetts Curriculum Frameworks and existing national standards. They have been developed by teachers and administrators from the Boston Public Schools, in collaboration with content area experts from local colleges and universities, parents, students and other members of the Boston Public Schools community.

Why do we need new standards and frameworks?

The Commonwealth of Massachusetts has developed new curriculum frameworks, including standards that define the state's expectations of students throughout the Commonwealth. By the close of this decade, students will be expected to achieve these standards as a condition of graduation from high school.

As of 1995, the Boston Public Schools did not have similar, clearly-defined expectations of our students. The schools were guided by curriculum objectives developed in the early 1980s that needed to be updated and aligned with the new state frameworks. As administrations and priorities changed over the previous decade, as the content base expanded in each subject area, and as technology allowed us to reach further than we may have ever hoped to grasp, our curriculum objectives became more dated. Though many of them are included in the state frameworks, many others were in need of revision.

What do the standards and frameworks include?

The Boston Public Schools Citywide Learning Standards and Curriculum Frameworks include two sections that present the system's expectations of students to increasing degrees of specificity. The first of these sections, the Boston Public Schools' Vision Statements for Elementary, Middle, and High School Graduates, include:

- Academic Skills and Understandings: brief, summative statements, written for important skill and content areas, summarizing key standards for fifth, eighth, and twelfth grade students
- Habits of Mind and Work: key attributes essential for success in any endeavor, at any age, in or outside of school. These habits are closely aligned with the habits promoted in the Massachusetts Curriculum Frameworks. Every teacher shares the responsibility to promote, nurture, and assess students' development of these habits.
- The Graduation Portfolio: brief descriptions of selected products students will be expected to complete, by the end of the fifth, eighth, and twelfth grades, to demonstrate their achievement of grade level standards
- Course and Test Requirements: completion requirements for all students in elementary, middle, and high school, in English Language Arts, Mathematics, Science, and Social Studies

The second of these two sections present the system's expectations of students in much greater detail. This section includes:

- Learning Standards: a description of what students must know and be able to do, in English Language Arts, Mathematics, Science, and Social Studies, at each grade level, and
- Curriculum Frameworks: important elements that provide additional structure to the curriculum, and additional direction to teachers and students alike, including:
 - *Content and Skill Objectives*: more detailed descriptions of each learning standard
 - *Key Questions*: challenging, open-ended questions students will be expected to investigate and answer well, as a condition of promotion and course completion
 - *Student Requirements*: the products, tasks, and tests students will be required to successfully complete, as a condition of promotion and course completion
 - *Task Descriptions*: detailed descriptions of each element included in the required products, explaining in precise terms what is expected of students

Note: The task descriptions are currently under development. They will be finished this summer and piloted during the 1996-97 school year.

Why these standards and frameworks?

Our standards and frameworks have been developed to align with the Massachusetts Curriculum Frameworks and nationally recognized standards in English Language Arts, Mathematics, Science, and Social Studies. We have identified standards that are appropriate for the different grade levels, and that outline expectations comparable to those in high performing districts throughout the Commonwealth. We have considered the expectations of the world of work, including the competencies outlined in the SCANS Report for America 2000, commissioned by the Department of Labor. We have used the College Board's "Academic Preparation for College: What Students Need to Know and Be Able to Do", as a point of departure in considering the expectations of colleges and universities around the country. We have conducted focus groups, including parents, students, teachers, university faculty, and other members of the community, to consider and respond to our draft standards and frameworks, in light of their expectations of students.

We have also considered the materials that are, or will be, available to teachers throughout the grade levels, when considering the content we expect students to master. Though standards and frameworks should not be developed with a particular set of materials in mind, we paid close attention to the exemplary materials that have, and are being developed, particularly in mathematics and science, as we developed our grade-level content standards and frameworks.

In addition, we developed standards and frameworks for each of the content areas that require students to learn how to learn; to ask and answer probing questions; to read analytically; to

write with clarity and precision; to observe, interpret, and appreciate the world around them; to understand and be considerate of others; to look for point of view, as well as bias and prejudice; and to develop deep understandings rather than the superficial recognition of facts.

These are the standards and curriculum frameworks that guide our teachers, other staff, and external partners in identifying, designing, and implementing curriculum, materials, and teaching and learning strategies for all of our students. The standards and curriculum frameworks chart a course to prepare our students for the world of work in the twenty-first century, and for college should they choose to attend.

Who are these standards for?

The standards we have developed are for *all* students. All students will be expected to master the same content, at or above prescribed levels of proficiency. Students with limited English proficiency or with special educational needs will be able to demonstrate achievement of these standards in ways that are different from those employed by regular education students.

Students with limited English proficiency, who have not completed their transition to regular education classes, may study content and complete assessments in their first language. These students will not be required to demonstrate proficiency in English at a level comparable to regular education students. They *will* be required to demonstrate proficiency in their native language, at similar levels of proficiency.

In addition, students who are enrolled in the transitional bilingual education program will be required to demonstrate English language proficiency at the level prescribed in the Boston Public Schools' English as a Second Language standard (to be developed in 1996-97).

For students with identified special educational needs, their individual educational plans will state the learning standards as curriculum goals, along with accommodations, levels of expectations, and performance modifications for how they will meet the standards. There is one set of standards, but how students will demonstrate achievement must be determined on an individual basis that takes into consideration individual learning needs.

A Sense of Balance: Depth and Breadth

We have attempted to balance the often-competing goals of depth and breadth in constructing our standards and curriculum frameworks. On the one hand, we expect students to have the opportunity to pursue topics and ideas until they truly understand them, and to master the processes involved in reaching deep understanding. On the other hand, we have also tried to ensure students have a breadth of knowledge that will allow them to compete with other graduates outside of school, and to pursue meaningful careers and post-secondary studies.

A Work in Progress:

The learning standards and curriculum frameworks were produced through the efforts of hundreds of teachers, administrators, parents, students, university partners, and other community members who participated on subject area teams, task groups, and focus groups. Parent groups and interested individuals also received the documents and gave recommendations. The involvement of parents and other individuals, particularly during the decision-making process on which recommendations to include, was an important component in the development of the standards. Though we are confident we have established rigorous, high-quality standards, and have provided a thoughtful framework to help teachers translate these standards into curriculum, we recognize that many questions remain, that we need to answer during the implementation process. For example:

- Have we struck the proper balance between depth and breadth?
- Do these standards include all that our students must know and be able to do?
Do they include too much?
- Do these standards and frameworks set the proper course to prepare students for the statewide assessments they must pass as a condition of graduation?
- Are the standards and frameworks really helpful to teachers?

- Do we provide enough flexibility to allow students and teachers to pursue valuable, individual interests?
- Can all of this work be completed in the time that is available to us? If yes, how?

Over the course of the next few years, as part of an annual spring review process, we expect to answer these questions (and more), and to make adjustments to improve the standards and frameworks. Just as the process we employed to develop these standards and frameworks engaged hundreds of teachers, parents, students, administrators, and community members, so too will this continuous improvement process.

First Steps: Building the Curriculum

These learning standards and curriculum frameworks set our expectations. They must be brought to life by the creative work of individual teachers. Beginning next year, teachers will begin to expand the standards and frameworks into full curricula, including teacher-developed unit guides and lesson plans, and teacher-selected materials and instructional strategies they feel will best meet our students' needs. As they do so, they will test the value and utility of the standards and frameworks in the only place they really counts: the classroom. Their findings will greatly influence any changes we may choose to make.

Simultaneously, to support the transition from identification of standards and frameworks to actual change in classroom practices, schools and central office will provide professional development opportunities for teachers and staff on curriculum development and instructional assessment practices. Parents will work with the schools and central office to develop and implement a "home" curriculum.

An Open Invitation:

We have embarked upon a course, and a challenge, for which there are few signposts. Our success will depend upon the sustained commitment of everyone engaged in the education of our children, and we want you to be involved. Please send any comments or recommendations you might have to Teaching and Learning Support Services, Boston Public Schools, 26 Court St., 6th Floor, Boston, MA 02108.

The Boston Public Schools' Vision of the Elementary School Graduate

The following skills and understandings are essential to students' success in elementary school. They represent standards we expect every elementary student to achieve. Every teacher, administrator, and other adult involved in the lives of our students, bilingual, special education, and regular education students alike, shares in the responsibility to ensure that all students achieve these standards.

Academic Skills and Understandings:

- **Reading and Literature:** Students read, understand, and appreciate challenging literature and other materials written at a level of difficulty similar to Bette Bao Lord's In the Year of the Boar and Jackie Robinson and National Geographic's *World* magazine.
- **Writing:** Students write legibly and effectively for a variety of purposes, demonstrating an understanding of the writing process and mastery of the basic writing conventions.
- **Speaking, Listening, and Presenting:** Students deliver effective oral presentations, identify the key ideas and supporting details in others' presentations, and ask thoughtful questions for clarification and additional information.
- **Mathematics:** Students add, subtract, multiply, and divide whole numbers, fractions, decimals, and percentages; they apply introductory concepts from geometry, algebra, probability, statistics, and discrete mathematics to the completion of real-world tasks and the solution of real-world problems.
- **Science:** Students use science facts, concepts, and procedures to observe, describe, and discuss the way nature works; they collect evidence, make inferences, and construct models to explain important concepts.
- **Social Studies/History/Geography:** Students have a working knowledge of the continents, major countries, the United States, maps and globes; they organize information chronologically, understand the concept of historical perspective, and evaluate arguments from more than one perspective; they understand the basic principles of democracy, and their development.
- **World Languages:** Students ask and answer simple questions about their families, friends, school, and neighborhood; they write in simple contexts.
- **Health:** Students relate concepts of health promotion, disease prevention, and risk assessment to the development of health-enhancing behaviors.
- **The Arts:** Students employ the arts to communicate their beliefs, experiences, ideas, and imagination.
- **Career Awareness:** Students make connections between the academic and social/behavioral requirements of school and the requirements of specific jobs and careers.
- **Research and Study Skills:** Students take notes, organize their work, use the library to acquire information, and complete their homework each day.
- **Technology:** Students use technology to gather information, solve problems, complete and present their work, and increase their capacity to tackle challenging tasks.

The Habits of Mind and Work: The following habits are also essential to students' success in elementary school. They are the shared responsibility of every teacher, administrator, and other adult involved in the lives of our children.

- **Curiosity and Critical Thinking:** Students listen attentively, observe carefully, and ask thoughtful questions until they understand; they look for good evidence.
- **Respect for Diversity:** Students recognize and value racial, ethnic, cultural, age, gender, and individual commonalities and differences; they respect other people's points of view.
- **Consideration and Compassion:** Students treat themselves and others with care and respect; they build trusting relationships; they help, care for, and share with one another.
- **Collaboration:** Students work well with others, give and accept constructive criticism, try to be fair, and try to solve problems in a reasonable, peaceful manner.
- **Self-Direction:** Students check their own work, invite the critical response of others, and make appropriate adjustments.
- **Perseverance:** Students work hard until the job is done right, and are patient when the answers do not come quickly.
- **Initiative:** Students try new things, take reasonable risks, and reflect on their successes and mistakes.
- **Courage:** Students stand up for their rights and the rights of others in a positive manner that shows self-respect and respect for others; they resist harmful pressures.
- **Responsibility:** Students demonstrate personal responsibility and pursue important goals for themselves and their schools.

The Graduation Portfolio:

Students will complete a portfolio of their work, demonstrating their acquisition of important skills, understandings, and habits. The products in the portfolio will include the following:

1. **Essay:** an essay of three or more paragraphs on a controversial issue. The essay should define the conflict, explore various options for solving the conflict, provide arguments for each option, select the best option, and provide a convincing argument for the option chosen.
2. **Geography Project:** Given an outline map of the United States, including a distance scale and coordinates, students will identify each state; major rivers and bodies of water; one or more major cities in each state; major landforms; major business, industrial, and agricultural centers; time zones; population centers; and prevailing climates, by area. Students will identify points on the map, given coordinates or coordinates of origin, plus direction and distance. Finally, students will select one city, state, or region and in two pages or less:
 - Discuss trends of economic and population growth and decline
 - Demonstrate how human actions (e.g. pollution) affected the environment
 - Demonstrate how the local geography affects human systems (e.g. housing)
 - Suggest how things might have turned out differently (economically) if someone had acted differently, or if some important event had not happened
3. **Science Activity Report:** a scientific report answering, at least in part, one or more key questions. The report contains data, illustrations, charts, and written descriptions of personal observations and interpretations of a particular phenomena or object.
4. **Research Paper:** a research paper on a selected theme or topic. Students read at least two works on the topic and gather additional information. The paper is designed to introduce students to the research process, teach them how to organize large quantities of information, improve their library skills, and expose them to a variety of sources and materials
5. **Math Projects:** projects that require the student to apply the fundamental concepts included in the standards, to the solution of real-world challenges or problems.
6. **Physical Challenge:** a certificate of completion of a physical challenge activity.
7. **Collaborative Project:** a collaborative project in which the student applies his or her learnings to educate others, or to serve the school in some capacity.
8. **Career Exploration:** a project through which the student explores a selected career, including a student-written job description, educational (and other) requirements, and job and salary prospects, through readings and interviews, where available.
9. **Autobiographical Narrative:** a description of an important event (orally and/or in writing), related as a story, with characters (including themselves), a setting, and a beginning, middle, and end. Students present their own thoughts and feelings as well as those of another character. They also discuss what they learned from the event. The product should include written work and pictures, drawings, photos, or other works of art.
10. **Work of Art:** an original work, independent or in support of one of the above products.

Each of these products will be assessed using standards and rubrics that are familiar to students. The portfolios will be available to students and parents on an ongoing basis, and will serve as the foundation for regular teacher-student-parent conferences. Graduation portfolios will be fully implemented within the next five years.

Grade-Level and Test Requirements:

English Language Arts: All students will be enrolled in the English Language Arts curriculum during each year in elementary school. Students enrolled in Transitional Bilingual Education programs will meet this requirement in accordance with the English-as-a-Second Language (ESL) standards (to be developed during 1996-97)¹. Each student is required to successfully complete all grade level requirements each year.

Mathematics: Each student will be enrolled in mathematics during each year in elementary school. Each student is required to successfully complete all grade level requirements each year.

Science: Each student will be enrolled in science during each year in elementary school². Each student is required to successfully complete all grade level requirements each year.

Social Studies: Each student will be enrolled in social studies, including history and geography, during each year in elementary school². Each student is required to successfully complete all grade level requirements each year.

The Habits of Mind and Work: Each student will receive a satisfactory assessment for the habits of mind and work.

1. The State Department of Education is currently developing the assessment protocols for English Language Learners in accordance with the education reform legislation and MGL Chapter 71A.
2. Minimum time allocations for English/Language Arts, Mathematics, Science and Social Studies:
 - English/Language Arts and Mathematics: 225 minutes per week
 - Science and Social Studies
 - Kindergarten - Second Grade: 90 minutes per week
 - Third - Fifth Grade: 135 minutes per week

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**English Language Arts
Kindergarten-Fifth Grade**

**Version 96.1
June 28, 1996**

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English Language Arts: Introduction

The English Language Arts curriculum builds from three beliefs:

- all students need to become independent readers, fluent writers, articulate speakers, skilled listeners, discriminating viewers, and critical thinkers;
- all students need to experience and appreciate the beauty and power of language, to increase their capacity to imagine, to think, to employ language, and to understand; and
- a strong literature program is essential to the development of shared values, social skills, and social responsibility.

The following are key elements of the English Language Arts curriculum:

- *An Integrated Approach:* Skills development is combined with literature and language-rich activities. Students write and talk about what they read and watch; learn writing conventions by editing their own work and the work of others; improve their own writing by studying and modeling effective authors' use of language and conventions; read, write, present, and discuss on a daily basis.
- *An Emphasis on Whole Works of Literature:* Students read, discuss, analyze, and come to appreciate the power of whole books, on a regular basis.
- *A Common Core of Literature Representing Diverse Cultures:* Students read, discuss, understand, and appreciate a common set of great works of literature:
 - that explore problems and lessons from a variety of perspectives, eras, and places;
 - that engage students in a very personal manner;
 - that model the beauty and power of language; and
 - that help students to increase their understanding of the human experience.
- *A Focus on Inquiry:* Students explore and struggle with fundamental questions about the human experience and the structure of language and literature, and learn to construct their own meaning, and to generate their own answers, while considering the answers of others.
- *An Emphasis on Character Education:* The teaching of shared values, social skills, and social responsibility is an integral part of all literature and language arts activities. Students are encouraged to understand the perspective of others, to explore various ways to resolve conflicts, and to embrace a set of values that are shared by members of our community.
- *Meaningful Applications/Required Products/Portfolios:* Students are required to complete a variety of products that integrate their skills and understandings, are meaningful to them, and are valued in the world outside of school. These products are collected in portfolios available for review by the student, teacher, parents, and others.
- *An Emphasis on Process:* Students learn important reading, writing, organizing, presentation, and thinking strategies applicable to any task in or outside of school.
- *Daily Opportunities to Read, Write, Present, and Discuss:* Students engage in informal writing activities (e.g., journal and notebook entries, personal reflections, and summaries) on an ongoing basis; they have daily opportunities to speak, listen thoughtfully, present, and discuss; they have weekly opportunities to complete formal writing assignments (e.g., picture books, stories, letters, poems, reports, essays, research papers).

An English Language Arts curriculum including these elements produces students who:

- are lifelong readers who love reading and pursue it independently,
- enjoy writing and write with facility and clarity,
- are articulate, confident, and convincing when presenting to others,
- take pride in their work and confidently share it with others.

This approach to English Language Arts is not new. It builds on the work of Boston teachers who have successfully implemented this approach for a number of years. Our standards and curriculum framework have been developed in collaboration with many of these teachers.

English Language Arts: Principles

Reading/Literature:

- Reading is an active, constructive, and creative process that involves distinctive cognitive strategies before, during, and after reading. Good readers access prior knowledge, establish purpose, preview text, generate questions, make predictions, confirm and revise predictions, locate and clarify concepts that cause confusion, take mental or written notes, organize information into categories, and use text features such as illustrations and headings to acquire meaning from print.
- The central focus of primary grade instruction must be reading, and every element of the instructional program in the early grades must be organized to ensure success in reading for every student. From kindergarten through the second grade math, science, social studies, and other activities, should have a language arts base.
- Reading instruction should be flexible and based on individual needs. Some students come to school already reading. Some students experience initial difficulty and will need short-term intervention. Students with continuing reading difficulties will need a long-term, structured program.
- Ongoing assessment is an essential element of instruction. In kindergarten, first, and second grades, the focus of assessment should be on individual diagnosis rather than standardized achievement tests scores. Every kindergarten student needs to develop and be screened for emergent literacy skills with a quick and informal instrument. First graders need to be evaluated using a more systematic process of determining early reading progress. Students in need of additional help should be identified no later than mid-first grade and appropriate support strategies must be available.
- Powerful reading instruction connects literature (fiction and non-fiction), language, comprehension and skill instruction. Skills should not be taught in isolation.
- Phonics is one strategy in a comprehensive approach to reading instruction. Children get a better start in reading if they are taught phonics. Learning phonics helps them to understand the relationship between letters and sounds and to "break the code" that links the words they hear with the words they see in print. Because phonics is a reading strategy, it is best taught in the context of reading, not as a separate subject to be mastered. For the vast majority of students, phonics instruction should be concluded by the end of the third grade.
- Reading comprehension uses literature and language activities that should include many opportunities to read, write, and use oral language.
- A variety of whole class, small group, and individualized instruction is necessary to meet the diverse needs of students. Grouping should be flexible and based on students' interests and developmental needs. Grouping by developmental level for some skills instruction is useful as long as the grouping remains flexible with students reassigned as their needs and the tasks change.
- A strong literature program is essential to individual development and the development of community. Literature provides students with the opportunity:
 - to explore the fundamental questions of humanity;
 - to experience the lives of people from different cultures, eras, places, and economic conditions;
 - to understand their own experiences, feelings, perceptions, and concerns;
 - to recognize the universality of human emotion and experience;
 - to recognize and be sensitive to stereotypes based on race, religion, ethnicity, income, handicap, and gender;
 - to appreciate the beauty and power of language;
 - to appreciate the differences and utility of various genres;
 - to increase their capacity to imagine, to think, to employ language, and to understand.
- There is a core of traditional and contemporary literature that all children should study, understand, and value. This literature must represent and respect our diverse voices, experiences, beliefs and perspectives.

Writing:

- Good writing reflects and stimulates good thinking.
- Writing is a process including opportunities to plan (prewriting); to put initial ideas on paper in some organized context (drafting); to read aloud and reflect on the product, often in collaboration with others (editing); to revise and make corrections (rewriting); and to share the final product with others (publishing).
- The best way to fully develop writing as both an art and a skill is in a context where reading, writing, listening, speaking, viewing, and presenting all reinforce each other and none are taught in isolation.
- Students become competent learners by actively synthesizing, making connections for themselves, speaking their own thoughts and finally crafting those thoughts in writing in a way that is powerful and meaningful for them.
- Writing contributes strongly to reading comprehension; reading aloud contributes strongly to the quality of one's writing.
- Successful writers understand the structure and use of language and employ language creatively and effectively. Grammar and usage must be explicitly taught, from kindergarten through twelfth grade, as part of the writing and reading process. Grammar and usage improve most when students are:
 - regularly exposed to good models of writing, and speaking,
 - asked to study and analyze the grammatical structure and usage in the model,
 - required to write, edit, and rewrite their own work, and the work of others, until the grammar and usage meets the established standard.
- Writing assignments should emphasize writing for real purposes - including letters, notes, editorials, journals - in addition to academic assignments.
- Writing reinforces the idea that language has meaning and it allows students to take ownership of a work's language and structure.
- Spelling development for early readers should take place within the context of reading and writing activities, but other vehicles are also necessary including teaching groups of words that demonstrate sound and spelling patterns.
- Temporary spelling is useful in the primary grades to foster literacy and creativity, not to replace standard spelling.
- Vocabulary development is essential from K-12 to allow students to make specific and effective word choices (diction).

Speaking, Listening, and Presenting:

- Expressing oneself orally is essential to learning.
- Listening is an active, constructive, and creative process that involves distinctive cognitive strategies before, during, and after listening. Good listeners access prior knowledge, establish purpose, make predictions, confirm and revise predictions, generate questions, take mental or written notes, paraphrase content, check for understanding, identify and clarify concepts that cause confusion, and build from the presenter's ideas.
- Students need to learn the different speaking and listening strategies associated with communicating in everyday interpersonal situations; acquiring, interpreting, applying, and transmitting information; evaluating and generating information and ideas according to personal or objective criteria; and communicating for appreciation and entertainment.
- Students will make critical and cultural connections between oral language and written text and structures. This will be reinforced through the study of literature from a variety of cultures.
- Students' language needs to be valued. Students should be encouraged to talk; to listen carefully to one another; to take notes, paraphrase, and summarize what they've heard; and to express their ideas, opinions, and responses.

- Oral language development is important to early literacy. Teachers should engage children in oral language activities by reading to them and through meaningful discussions. Students should be encouraged to read aloud to one another and to discuss what they have read.
- Students need practice, practice, and more practice developing their oral language skills, with a particular emphasis on good diction (pronunciation and elocution).
- Students need practice, practice, and more practice developing their listening skills, with a particular emphasis on understanding what others have said and meant, in the interest of learning from and building on their ideas.

Viewing:

- Viewing "literacy" is an essential competency to be developed by all students.
- Viewing plays, television, video, film, other productions and works of art, as well as natural phenomena is an active and critical process that involves distinctive cognitive strategies before, during, and after viewing. Good viewers access prior knowledge, establish purpose, make predictions, confirm and revise predictions, generate questions, take mental or written notes, paraphrase content, check for understanding, and identify and clarify ideas or concepts that cause confusion.
- Students need to make informed judgments about plays, television, film, and other productions and works of art.

Research & Study Skills: Effective learners....

- Know how to gather and analyze information.
- Make optimal use of all available resources, and most particularly, the library.
- Organize information into categories and outlines.
- Record directions; clarify the task by asking good questions; set goals and timelines; and organize time, materials, and resources to reach these goals in an efficient and effective manner.
- Employ effective strategies to preview text and other materials.
- Employ a variety of study skills including writing-to-learn-strategies (e.g. learning logs, response journals, note taking)

Social Skills:

- A primary goal of education is to promote the development of students' social skills and values.
- One important way students learn to express themselves, and become aware of other people's points of view, is by developing strong perspective-taking skills.
- The development of students' conflict-resolution skills builds on their perspective-taking ability; it enables them to resolve conflicts and promote their own autonomy, while respecting the dignity of those they are in conflict with.
- These two social skills enable students to form healthy relationships in which both persons care for one another and help each other be self-determining.
- The careful development of social skills and values leads to healthy relationships and the improvement of students' literacy skills. The development of students' perspective-taking skills directly influences their ability to speak, listen, read, and write.
- The development of students' social and literacy skills contributes to the prevention of violent behavior on their part, and diminishes their use of alcohol and other drugs.

K-2 Skill Objectives: Timeline

- STRAND #1 - ORAL LANGUAGE, LISTENING, AND SPEAKING						
Standard	KI	KII	1st Grade - Fall	1st Grade- Spring	2nd Grade	Continuing Grades
The student listens carefully and engages in discussions.	• Listens to and discusses a variety of texts, both fiction and nonfiction • Listens for information • Follows directions • Takes turns during discussions and listens to others					
	• Listens to other perspectives or views					• Provides feedback and confirmation when listening to others
The student uses effective oral language.	• Tells a story or talks about an event from their own experiences • Retells a main event from a story that has been read to them • Participates in rhymes and songs, orally and through movement and choral speaking • Understands that the purpose of language is for communication					
	• Gives descriptions; expresses feelings and opinions • Responds to questions concerning personal information (birth date, address and telephone number) • Dictates stories, ideas and opinions • Participates in group discussions • Uses expressive language to describe • Participates in choral reading					
	• Gives explanations • Recites familiar poems and passages • Participates in class plays, performances, and Reader's Theaters • Makes oral presentations and reports					
	• Uses more complex, detailed and precise language • States reasons for supporting a statement or an opinion					

Note: To avoid repetition in this chart, each activity is first listed during the year it is introduced, and the shaded area that follows represents the subsequent years in which that activity occurs.

• STRAND #2 - AWARENESS OF SOUND, SYMBOL, AND STRUCTURE

Standard	KI	KII	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
The student develops phonemic awareness.	• Develops awareness of letter-sound relationships • Hears separate words in a sentence or passage					
			• Is exposed to word families (e.g., "cat to fat") • Recognizes and hears rhyming words • Matches sounds of letters to pictures and words			
			• Hears the phonemic blending in words (<i>c-a-t</i>)			
			• Understands more complex word families (e.g., "cat to char") • Hears syllables • Hears and segment initial and final phonemes	• Understands more complex segmenting, blending and transpositions (g.3)	• Hears and segment initial, final and medial phonemes	through 4th Grade through 3rd Grade through 3rd Grade
			• Hears syllables in words	• Understands more complex segmenting and blending (stretch to stretch, monitor to monitor)		

Note: To avoid repetition in this chart, each activity is first listed during the year it is introduced, and the shaded area that follows represents the subsequent years in which that activity occurs.

- STRAND #2 - AWARENESS OF SOUND, SYMBOL, AND STRUCTURE (continued)

Standard	KI	KII	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
The Student develops syntactic awareness.	• Uses oral language structure properly	• Understands how words, phrases, sentences, and questions are used for meaning • Begins to use the language of books in speaking and writing				
			• Reads punctuation • Understands sentence and story structure • Uses beginning grammar			
			• Uses more complex grammar • Identifies paragraphing • Understands formal language structure of stories, poems, books... • Understands expressions and figurative language			
The student uses phonics, decoding, & word attack skills		• Knows most letter/sound correspondences • Begins to recognize word family patterns	• Names the letter for the initial sound in a picture/word			
			• Knows basic letter-sound correspondences for all letters - sounds out to decode words - uses initial letters as cue to decoding - uses knowledge of common letter patterns to decode words - uses known part of words to make sense of the whole word - uses blending to decode words, e.g. str-ing - uses word segmentation and syllabication to make sense of whole word - recognizes high frequency words (at least 50)			
			• Uses graphophonic, semantic, and syntactic cues			
through 3rd Grade						

through 3rd Grade

- STRAND #2 - AWARENESS OF SOUND, SYMBOL, AND STRUCTURE (continued)

Standard	KI	KII	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
The Student uses phonics, decoding, & word attack skills (cont.)					• Uses the following word identification strategies - uses graphophonic knowledge and "sounding out" - blending - more complex letter and word patterns - sight words (at least 150 words) - more complex syllabification and segmentation - knowledge of root words and word components	
The student develops print & letter awareness.	• Recognizes own first name • Recognizes familiar signs and print in the environment • Develops awareness that print conveys meaning • Is exposed to letter names & alphabet • Knows the names of some letters • Is exposed to upper and lower case letter names/sounds at the same time					

Note: To avoid repetition in this chart, each activity is first listed during the year it is introduced, and the shaded area that follows represents the subsequent years in which that activity occurs.

- STRAND #2 - AWARENESS OF SOUND, SYMBOL, AND STRUCTURE (continued)						
Standard	K I	K II	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
Print Awareness/ Letter Awareness (cont.)	• Has concept of "letter" and "word" • Knows the names and sounds for all upper and lower case letters • Locates letters in text (first, last, upper, and lower)					
The student develops introductory book knowledge.			• Understands concepts of punctuation marks, sentence, paragraph		through 3rd Grade	
	• Understands the meaning of title, author, and illustrator • Demonstrates left to right directionality when tracking print • Locates spaces between words • Demonstrates one to one correspondence when tracking print • Uses return sweep • Names simple punctuation and state its use					

Note: To avoid repetition in this chart, each activity is first listed during the year it is introduced, and the shaded area that follows represents the subsequent years in which that activity occurs.

- STRAND #3 - SKILLS INTEGRATION

Standard	KI	KII	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
The student builds concepts about print .	• Knows that the message of print stays constant • Knows the front/back, top/ bottom of the book • Turns pages one at a time • Knows left to right page progression • Develops awareness of the concept of a "letter" and concept of a "word"					
The student recognizes and uses letters.	• Uses pictures as cues for story and print		• Knows all letter names, sounds, formations (upper/lower case) • Applies letter/sound correspondence to writing and decoding			
			• Automatically recognizes high frequency words in text (at least 50 words) • Self corrects and self monitors when reading			
The student reads orally.			• Integrates sources of information from text (cross check text with semantic, syntactic, and graphophonic cues)			
			• Automatically recognizes high frequency words in text (at least 150 words from word bank): 2nd Grade/Expanding Thereafter			
Word Families, Word Patterns, Word Play			• Recognizes most primary word families and patterns			
			• Applies basic word families and patterns to unfamiliar words when reading or writing			
			• Applies word families when writing and reading unfamiliar words			

- STRAND #4 - READING AND COMPREHENSION STRATEGIES

Standard	KI	KII	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
The student reads and participates in reading with others.	• "Reads" and hears stories, songs, rhymes, poems, chants, finger plays..					
	<u>Note:</u> "Reads" in KI-II means the child initiates and approximates reading behavior..					
	• Engages in reading-like behaviors					
	• Uses the classroom, school, and neighborhood library • Is read to at home					
	• Reads specifically-designed books (patterned text, repetition, predictability....) • Participates in shared reading					
The student reads on his or her own.	• Participates in guided reading • Reads independently					
	• Participates in individual & small group readings of simple text • Reads 100-200 little books (or has them read to them)					
	• Practices silent, sustained reading					
	• Reads narrative and informational text as the primary learning strategy • Reads and discusses stories, magazines, and informational texts					
	• Reads a book or story each day • Reads and recognizes different genres and a variety of content and subject areas					
The student reads on his or her own.	• Is exposed to fiction (fairy tales, poems, stories...) • Is exposed to non-fiction • Is exposed to multicultural literature					
	• Is exposed to various genres					
	• Reads fiction (fairy tales, poems, stories...) • Reads non-fiction • Reads multicultural literature					

- STRAND #4 - READING AND COMPREHENSION STRATEGIES (continued)

Standard	KI	KII	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
The student develops initial comprehension strategies.	• Uses picture books and simple story books to read for meaning • Begins building background knowledge					
	• Begins to make predictions about text patterns and story content		• Understands simple story structure (main events, characters, problem, solution) • Attends to some details			
			• Makes predictions using illustrations, text, and background knowledge • Uses background knowledge, story content, text patterns, and other clues to build meaning • Begins to reflect and connect stories to personal experiences			
			• Uses a range of strategies automatically when reading for meaning - self-corrects - re-reads - reads on - slows down - sub-vocalizes - self-monitors • Uses background knowledge to build meaning • Discusses story structure (setting, characters, plot, conflict, solutions) • Summarizes the main points with story maps • Responds and reflects critically on literature			• Uses knowledge of print conventions (e.g. capitalization and punctuation marks) • Uses more advanced reading strategies (scanning, mapping, visualizing) • Locates specific information from reading • Distinguishes fact from opinion • Summarizes readings • Participates in in-depth discussions on story structure (plot, setting, characterization, conflict, solutions, alternative endings, other views) • Compares and contrasts stories, characters, problems...

Note: To avoid repetition in this chart, each activity is first listed during the year it is introduced, and the shaded area that follows represents the subsequent years in which that activity occurs.

- STRAND #4 - READING AND COMPREHENSION STRATEGIES (continued)

Standard	K I	K II	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
The student reads content area materials.	• Is exposed to math reading (counting books), social studies reading, and science reading					
The student develops initial fluency.			• Reads newspapers and magazines (or has them read to them) • Uses beginning references materials			
	• Practices reading familiar text fluently (books, little books) • Recites familiar materials • "Reads" orally		• Uses expression and phrasing			

- STRAND #5 - WRITING, VOCABULARY, AND SPELLING

Standard	K I	K II	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
The student develops early writing and encoding skills.	• Uses some letter formations • Writes first name using upper and lower case letters					
	• Engages in emergent writing • Makes signs • Copies words for labeling	• Writes first and last name using upper and lower case letters				
		• Forms all upper and lower case letters	• Participates in group interactive writing • Writes letter for the initial sound in pictures and words			
			• Writes words (temporary or invented spelling) • Hears and records letter sound in words			
	• Dictates or composes a variety of stories					

- STRAND #5 - WRITING, VOCABULARY, AND SPELLING (continued)

Standard	KI	KII	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
Writing and Encoding (continued)			• Uses beginning grammar • Uses appropriate spacing and letter formation in handwriting (printing) • Uses basic mechanics (end punctuation, quotations marks, beginning capitalization) • Composes a variety of texts	• Uses standard conventions of writing • Writes narratives, expository texts (e.g. organizing information for a report)	• Writes more complex, organized narratives, reports and descriptions using the five-step process of prewriting, drafting, revising, editing, "publishing" • Uses various sentence structures in compositions and paragraphs	
		• Spells some sight words • Uses temporary spelling	• Transitions to conventional spelling • Spells words from the reading lesson • Spells words from word families • Builds simple words with magnetic letters and other manipulatives • Spells high-frequency words (from word bank)		• Spells words from content areas • Knows unconventional spellings • Learns words from personalized spelling lists re: readings and writing assignments • Spells words from lists organized by sound, theme, and/or common parts	

Note: To avoid repetition in this chart, each activity is first listed during the year it is introduced, and the shaded area that follows represents the subsequent years in which that activity occurs.

- STRAND #5 - WRITING, VOCABULARY, AND SPELLING (continued)

Standard	KI	KII	1st Grade - Fall	1st Grade - Spring	2nd Grade	Continuing Grades
The student builds an understanding of words and demonstrates a strong, grade-level appropriate vocabulary.	• Increase vocabulary through pictures					
	• Gains word meaning from stories and oral discussions and explanations					
	• Builds vocabulary through concrete learning experiences					
		• Builds simple words with magnetic letters and other manipulatives				
		• Builds vocabulary through concrete and experiential learning				
		• Categorizes and classifies words, objects, and pictures				
		• Learns new words from readings and writing assignments				
			• Constructs words by adding endings, prefixes, and suffixes			
			• Builds vocabulary and usage through oral and written exercises			
					• Learns terms from context	
					• Uses root words and affixes	
					• Uses synonyms and antonyms	
					• Uses descriptive and active words and phrases	

Note: To avoid repetition in this chart, each activity is first listed during the year it is introduced, and the shaded area that follows represents the subsequent years in which that activity occurs.

- STRAND #6 - PERSPECTIVE-TAKING & CONFLICT-RESOLUTION SKILLS

Standard	Kindergarten 1-2	1st - 2nd Grade	3rd - 5th Grade
Students understand and express points of view.	Students: • use "I" to express their point of view • express their own feelings and reasons • describe their own words and actions, and those of other people	Students: • use "you" to express another person's point of view • express the thoughts and feelings of another person • coordinate thoughts and feelings with words and actions • determine intentionality of actions	Students: • express another person's views of their own viewpoints • describe complex and contradictory feelings • distinguish between appearances and inner reality
Students employ various conflict resolution strategies.	Students: • act unilaterally to resolve a conflict when another person won't listen (e.g., walk away, take time out, defend themselves)	Students: • use impartial rules to resolve conflicts and acknowledge they have to coordinate their actions with those of others (e.g., take turns, flip a coin, throw fingers)	Students: • use reason to try to convince other people of their positions • listen sincerely to other people

Student Requirements:

The following pages include products and tasks that will be implemented over the next five years, that students will be expected to complete as a condition of grade-level completion.

1996-97: All students are expected to successfully complete "Reading Reviews" during the coming school year. In addition, teachers, working together in grade-level or whole-school teams, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, or conflict-resolution; and one other product that focuses on writing, that all students in your grade or school will successfully complete during the 1996-97 school year.

Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Student Requirements: English Language Arts, Kindergarten 1 & 2

By the close of Kindergarten 1 & 2, students will successfully complete the following products for inclusion in their portfolio. Teachers are encouraged to combine these with other products from other subject areas:

- **Reading Reviews:** Students will have at least two works read to them each day in all half-day kindergarten programs, and at least three works will be read to them in all full-day programs. The readings will include a variety of genres, including picture books, songs, chants, poems, and finger plays. Readings will be about a wide variety of cultures, and include traditional as well as contemporary works. Students will produce two products per week related to any of these readings, or others that are read to them at home, to satisfy this requirement. Students will demonstrate understanding by dictating and/or illustrating a personal response to a story each day, or to a character in the story.
- **Theme & Author Study:** Students explore two works that focus on a common theme or written by a single author and compare and contrast these two works, including the characters, the story structure, and the author's use of language. The student's product will include written work, illustrations, or a story map.
- **Autobiography - Drawing or Story of Self:** Students describe an event in their lives (orally with dictation and/or by illustration) that relates to a particular theme, goal, or common experience from book that has been read in class. They locate themselves in the story or drawing as the main character and they explain what they said or did.
- **Essay - My Point of View:** Students will illustrate and/or dictate their point of view on a topic or problem of importance to them.
- **Letter - Describing Myself:** Students dictate, illustrate, and send a letter or card in which they describe themselves.
- **Literature Circle/Recitation:** Students participate in frequent literature circles. They discuss story structure: theme, characters, problems and solutions, and their own response to the work. Students recite a favorite poem or passage from memory.
- **Language Experience:** Students write a group chart including a beginning, middle, and end, about a class activity or experience. Each child will illustrate one portion of the activity or experience.
- **Perspective Taking Exercise - My Point of View:** Students draw a picture on a selected theme or goal from a book they have read in class and explain it to their partners. Next, they stand "in their own shoes" in front of the class and explain their drawing to the whole class. The emphasis is on the students expressing their own points of view.
- **Conflict Resolution Exercise - Acting on Your Own:** Students discuss a conflict from one of their books with their partners. Next, they roleplay or illustrate how they would resolve the conflict using the Ask, Brainstorm, Choose (ABC) approach to conflict resolution with an emphasis on one-way conflict resolution strategies, e.g., walk away, take time out, or defend yourself. (see *Voices of Love and Freedom* Teacher Guide for additional directions)

Student Requirements: English Language Arts, First Grade

By the close of first grade, students will successfully complete the following products for inclusion in their portfolio. Teachers are encouraged to combine these with other products from other subject areas:

- **Reading Reviews:** Students read (or have read to them) at least thirty books (fiction and non-fiction) and at least ten other selections (poems, chants, magazines, newspapers) that they will "review". Students should review works from their reading series, ten works from the Voices of Love and Freedom program, and other selections they read in school, at home, or on their own. Students' selections will include traditional and contemporary literature, various genres, and at least three different cultures. To demonstrate understanding of each selection, students will respond, orally or in writing. Their response may include the following:
 - a summary of the work
 - a description of a selected character (feelings, thoughts, and reasoning)
 - an illustration
 - a personal response to the work
 - answers to one or more "key questions" (see "Content Objectives")
- **Theme & Author Study:** Students explore two works that focus on a common theme or written by a single author and compare and contrast these two works, including the characters, the story structure, and the author's use of language. The student's product will include written work, illustrations, or a story map.
- **Autobiography:** Students describe an event in their lives, orally and/or in writing, that relates to a particular theme or goal from a book that has been read in class. They demonstrate an understanding of sequence (beginning, middle, end). They describe their own thoughts and feelings at the time of the event and they describe the setting. The product can include written work, pictures, drawings, photos or other works of art.
- **Essay/Speech - My Point of View:** Students will present their point of view, orally and/or in writing, on a theme, goal, or problem of importance to them, and give one or more reasons why they selected this point of view.
- **Letter - Describing My Thoughts and Feelings:** Students write (and send) a neat, legible, well-organized letter or thank you note to a classmate, friend, relative or guest reader in which they describe their thoughts and feelings about a selected theme, topic, book, or event.
- **Literature Circles/Recitation:** Students participate in frequent literature circles. They discuss story structure; theme, characters, problems and solutions, and their own response to the work. Students recite a favorite poem or passage from memory.
- **Inquiry Project:** Students keep a journal; record or illustrate observations of changes in some person, place, or thing; and share their observations with others.
- **Original Work:** Students write or present an original narrative or descriptive work (e.g. adaptation/ innovation, picture book, poem, song, an alphabet book, a number book; description of a friend, family member, or scene). Students present their work and discuss it with classmates.
- **Perspective Taking Exercise - My Point of View:** Students, working in pairs, share personal experiences related to a selected theme or goal from a book they have read in class. Next, they stand "in their own shoes" in front of the class and tell their story to the whole class. Their stories have a beginning, middle and end and they are able to describe their own thoughts and feelings. The emphasis continues to be on the students' expressing their own points of view.
- **Conflict Resolution Exercise - Using Rules:** Students discuss a conflict from one of their books with their partners. Next, they roleplay or illustrate how they would resolve the conflict using the Ask, Brainstorm, Choose (ABC) approach to conflict resolution, with an emphasis on rule-based conflict resolution strategies, e.g., take turns or flip a coin. (see Voices of Love and Freedom Teacher Guides for additional directions)

Student Requirements: English Language Arts, Second Grade

Students will successfully complete the following products for inclusion in their portfolio. Teachers are encouraged to combine these with other products from other subject areas:

- **Reading Reviews:** Students read at least thirty books (fiction and non-fiction) and at least ten other selections (poems, chants, magazines, newspapers) that they will "review". Students should review works from their reading series, ten works from the Voices of Love and Freedom program, and other selections they read in school, at home, or on their own. Students' selections will include traditional and contemporary literature, various genres, and at least three different cultures. To demonstrate understanding of each selection, students will respond, orally or in writing. Their response may include the following:
 - a personal response to the work
 - a summary of the work
 - an illustration
 - a description of a selected character (feelings, thoughts, and reasoning)
 - answers to one or more "key questions" (see "Content Objectives")

Each student keeps a literature notebook including each of his/her reading reviews. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Theme & Author Study:** Students explore two works that focus on a common theme or written by a single author and compare and contrast these two works, including the characters, the story structure, and the author's use of language. The student's product will include written work, illustrations, or a story map.
- **Autobiography:** Students describe an event in their lives, orally and/or in writing, that relates to a particular theme or goal from a book from class. They demonstrate an understanding of sequence (beginning, middle, end). They describe their own thoughts and feelings at the time of the event, and they describe the setting. The product may include pictures, drawings, photos or other works of art.
- **Essay:** Students will present their point of view, in writing, on a theme, goal, or problem of importance to them, and give one or more reasons why they selected this point of view.
- **Letter - Asking About a Recipient's Thoughts and Feelings:** Students write (and send) a neat, legible, well-organized letter to a classmate, friend, relative or guest reader in which they describe their thoughts and feelings about a selected theme, topic, book, or event and ask questions of the recipient (including his/her view of the theme, topic, book, or event).
- **Literature Circles/Recitation:** Students participate in frequent literature circles. They discuss story structure: theme, characters, problems and solutions, and their own response to the work. Students recite a favorite poem or passage from memory.
- **Inquiry Project:** Students record or illustrate observations of changes in some person, place, or thing; they share their observations with others.
- **Original Work:** Students write or present an original narrative or descriptive work (e.g. adaptation/ innovation, picture book, poem, song; description of a friend, family member, or scene). Students present their work in class and discuss it with classmates.
- **Perspective Taking Exercise - Your Point of View:** Students, working in pairs, share personal experiences related to a selected theme or goal from a book they have read in class. Next, each student stands in the shoes of his or her partner and tells the class the story of his or her partner in the first person voice. The emphasis is on students learning to express the points of view of their partners, friends and family members.
- **Conflict Resolution Exercise - Using Rules:** Students discuss a conflict from one of their books with their partners and then roleplay, illustrate, or write about how they would resolve the conflict using the Ask, Brainstorm, Choose (ABC) approach to conflict resolution, with an emphasis on rule-based strategies, e.g., take turns or flip a coin. (see Voices of Love and Freedom Teacher Guides for additional directions)

English Language Arts: Skill Objectives

The skills identified on the following sheets are important to all third through fifth grade students. Students should develop these skills, to increasing degrees of sophistication, from grade level to grade level.

Every English teacher teaches these skills. Grade level differentiation comes:

- when students apply these skills to works of literature of increasing length and complexity,
- when these works of literature include increasingly sophisticated language,
- when students are asked to make increasingly complex and sophisticated observations, insights and assertions, and
- when students' writings are evaluated for increasing levels of proficiency and increasingly complex structure, language, and ideas.

In many cases the skills on the following chart remain similar across the grade levels. In some cases, differentiations are more explicit. However, even in these cases, it is understood that students' performance may vary, particularly during these early grades. We do ask teachers to focus on developing *particular* skills at different grade levels. These skills constitute our *focus correction areas* for the different grades.

In addition to this, examples of books that are included on the required and recommended reading lists for each grade level (our "Core Literature"), are included in the skill objectives on the accompanying sheets. These books represent the increasing degree of sophistication and complexity we expect students to manage from grade level to grade level.

Our Focus on Whole Works of Literature

A minimum of four complete chapter books should be taught in every English class each year, beginning in the 4th grade. These four books should come from the Core Literature list by school year 1998-99 (or earlier, if funds can be identified to purchase these books for each school).

The Core Literature list includes a single required reading for each grade level, and a list of recommended readings, differentiated by grade-level to ensure that students are not reading the same books year after year. Teachers' guides for next year's required readings will be completed this summer.

In the Spring of 1997, we expect to assess students' understanding of next year's required readings. Students' ability to perform the tasks included in these skill objectives will greatly influence their level of achievement on that assessment.

Skill Objectives: Grades 3-5 Timeline

- STRAND #1 - READING AND COMPREHENSION STRATEGIES			
Standard	3rd Grade	4th Grade	5th Grade
Students read and understand challenging materials (fiction and non-fiction).	- Students read and understand a variety of grade level materials, including fiction and non-fiction, books, reports, essays, and periodicals. Grade-level works of literature will include: 3rd Grade: Selections from school's literature series, Voices of Love and Freedom, and Literature Is Tops 4th Grade: Selections from school's literature series, Voices of Love and Freedom, Literature Is Tops, and four full works of literature (chapter books), which may be included in the above * 5th Grade: Selections from school's literature series, Voices of Love and Freedom, Literature Is Tops, and four full works of literature (chapter books), which may be included in the above * * By the close of this school year, a Core Literature list will be identified for the fourth and fifth grades. This list will include a single required reading for each grade level for 1996-97 (this selection will be changed from year to year), and a list of additional recommended readings, differentiated by grade level to ensure that students are not reading the same books year after year. A minimum of four complete chapter books should be taught in every fourth and fifth grade English class each year. These four books will come from the Core Literature list by school year 1998-99 (or earlier, if funds can be identified to purchase these books for each school). We expect to purchase a copy of the 4th and 5th grade required readings, for each student in each grade, through central funds, by the close of this school year. We also expect to complete teachers' guides for both of these books this summer. In the Spring of 1997, we expect to assess students' understanding of the 1996-97 required reading we've identified, to gather baseline data on student performance across the city. Students' ability to perform the tasks included in the skill objectives itemized on these sheets will determine their level of achievement on that assessment.		

• STRAND #1 - READING AND COMPREHENSION STRATEGIES (continued)

Standard	3rd Grade	4th Grade	5th Grade
Students analyze, interpret, and evaluate literature.	Non-Fiction: Students.... • identify the author's purpose (to inform or entertain;<i>3rd Grade</i>; persuade or inspire; <i>4th Grade</i>) • identify the main idea in a reading passage, from a variety of choices (<i>3rd Grade</i>); and independently (<i>5th Grade</i>) • identify key words, phrases, and other important details in a passage (<i>4th Grade</i>) • paraphrase and summarize at regular intervals (<i>with teacher support</i>; <i>3rd Grade</i>; independently; <i>5th Grade</i>) • distinguish fact from opinion (<i>3rd Grade</i>) • make and support assertions about the readings and support the assertions with evidence from the reading (<i>5th Grade</i>) • formulate probing questions about what they are reading (<i>5th Grade</i>) • compare, contrast, and evaluate two different accounts or views of the "same story" (<i>5th Grade</i>) • use important features, such as the cover and illustrations (<i>3rd Grade</i>), and chapter headings (<i>4th Grade</i>) to help construct understanding of the reading Fiction: Students.... • describe the structure (characters, problem, outcome, plot & sequence, author's goal, setting) of particular stories and books (<i>continued from earlier grades</i>; <i>increasing mastery through 5th Grade</i>) • identify key phrases, passages, and other important details to support a character, plot, or theme analysis (<i>5th Grade</i>) • paraphrase and summarize at regular intervals (<i>with teacher support</i>; <i>3rd Grade</i>; independently; <i>5th Grade</i>) • infer traits and feelings (<i>3rd Grade</i>), motives (<i>4th Grade</i>), and perspectives (<i>5th Grade</i>) of characters, based on what they do and say • make judgments about the characteristics and actions of characters (<i>3rd Grade</i>....) • explain how characters change or grow over the course of a reading (<i>4th Grade</i>) • identify simple figurative language (<i>3rd Grade</i>); identify simple figurative language (<i>5th Grade</i>) • make and support assertions about the readings and support the assertions with evidence from the reading (<i>5th Grade</i>) • predict outcomes or logical conclusions (<i>3rd Grade</i>....) • confirm or revise predictions on the basis of further reading (<i>5th Grade</i>) • formulate questions about what they are reading (<i>5th Grade</i>) • compare, contrast, and evaluate two different accounts or views of the same story (<i>3rd Grade</i>)		

- STRAND #1 - READING AND COMPREHENSION STRATEGIES (continued)

Standard	3rd Grade	4th Grade	5th Grade
Students understand literary structures.	Students know and understand... • the difference between fiction and non-fiction (<i>continued from earlier grades</i>) • the structure of fiction: character, plot & sequence, problem, outcome, setting, author's goal (<i>3rd Grade</i>) • the structure of non-fiction: main idea, supporting details, conclusion (<i>4th Grade</i>) • the basic genres of literature, including fiction, non-fiction, poetry, fable, plays, biography, autobiography (<i>3rd Grade</i>), short story, diary, editorial, essay, speech (<i>4th-5th Grade</i>)* • the proper terms associated with literary conventions and techniques, including simile, metaphor, alliteration, puns, foreshadowing (<i>5th Grade</i>) • identify uses of the literary conventions and techniques mentioned above, in specific readings (<i>5th Grade</i>)	* The genres emphasized in particular grade levels may vary by school, depending, in part, on the literature series individual schools have purchased. By the close of the fifth grade, students should meet this standard for all genres.	
Students connect what they read w/ their experiences, & the experiences of others.	Students... • identify and note what is new to them in what they are reading • use their prior knowledge to improve understanding • compare their own experiences to those of characters • construct graphic organizers		
- STRAND #2 - VOCABULARY			
Standard Students understand the structure of words and demonstrate a strong vocabulary.	3rd Grade Students... • expand their vocabulary through listening, reading, content area study, experience (<i>continued from earlier grades</i>) • use structural/contextual clues to determine meanings (<i>3rd Grade...</i>) • use a dictionary to find the meanings of unfamiliar words, pronunciations (<i>3rd Grade</i>)	4th Grade Students will know... • the meanings of words in age-appropriate reading material • synonyms, antonyms, and homonyms for the words in their reading material	5th Grade • the meanings of prefixes, suffixes, root words

- STRAND #3 - WRITING

Standard	3rd Grade	4th Grade	5th Grade
Students understand the structure of written language and employ this structure effectively, in their own writing.	In their stories, reports, poems, essays, and all other writings, students... • Use standard spellings (<i>3rd Grade</i>) • Use cursive writing (unless working on a word processor) (<i>3rd Grade</i>) • Punctuate sentences properly, including commas, apostrophes, quotation marks, periods, exclamation points, and question marks (<i>3rd Grade</i>); colons and semicolons (<i>5th Grade</i>) • Capitalize correctly (<i>3rd Grade</i>) • Use appropriate abbreviations: days, weeks, months of the year... (<i>4th Grade</i>) • Maintain subject-verb agreement and tense coherence (<i>4th Grade</i>) • Compose complete sentences, simple (<i>3rd Grade</i>), compound (<i>4th Grade</i>), and complex (<i>5th Grade</i>) • Compose declarative, interrogative, exclamatory sentences (<i>3rd Grade</i>); imperative (<i>4th Grade</i>) • Write well-developed, 3-5 sentence paragraphs (<i>3rd Grade</i>), one page papers: 2-3 paragraphs (<i>4th Grade</i>); and two-page papers (<i>5th Grade</i>), all organized in a logical order • Use transitional phrases effectively (<i>4th Grade</i>) • Understand and employ proper terms when discussing writings, including: - parts of speech: nouns, verbs, adjectives (<i>3rd Grade</i>); adverbs and prepositions (<i>4th Grade</i>); subjects and predicates (<i>5th Grade</i>) - verb tenses: present, past, future (<i>introduce: 3rd Grade; master: 5th Grade</i>)	In the process of completing any writing assignment, students... • Use the five-step process of <i>prewriting, drafting, revising, editing, and "publishing"</i> • Discuss one another's work and engage in peer editing (<i>3rd Grade...</i>)	In each of their writings, students... • Clearly present the topic (<i>4th Grade</i>) and purpose (<i>5th Grade</i>) of their writing • Provide details to support the main idea (<i>3rd Grade...</i>) • Organize events and thoughts in a logical order, including a clear beginning, middle, and end (<i>3rd Grade...</i>) • Stick to the topic (<i>3rd Grade...</i>) • Make choices about language to create the desired effect (<i>5th Grade</i>) • Include a strong beginning sentence (<i>4th Grade</i>) • Include a strong conclusion that brings the work to summation and leaves the reader with a strong impression (<i>5th Grade</i>)
Students understand and use the writing process effectively.			
Students' writing is focused, coherent, and well-organized.			

• STRAND #3 - WRITING (continued)

Standard	3rd Grade	4th Grade	5th Grade
Students employ a variety of formats and utilize technology to complete and enhance their work.	Students... • Use conventional formats for written products (e.g. left and right hand margins, adequate spacing between words and lines, paragraph indentation, sufficient "white space") • Use conventional formatting for friendly letters and letters of invitation (<i>3rd Grade</i>), and letters of inquiry (<i>4th-5th Grade</i>), including envelopes • Use conventional formatting for research papers, including sources (<i>4th-5th Grade</i>) • Word process published reports		

- STRAND #4 - ORAL LANGUAGE, LISTENING, AND SPEAKING

Standard	3rd Grade	4th Grade	5th Grade
Students engage in effective discussions.	Students... • Speak with appropriate loudness, clarity, speed, and phrasing (<i>continued from earlier grades</i>) • Ask clear questions (and answer them), using full sentences (<i>3rd Grade...</i>) • Exchange ideas and opinions (<i>3rd Grade...</i>) • Respect the turn-taking rights of others during discussions (<i>3rd Grade...</i>)		
Students make effective presentations.	Students... • Establish a clear purpose (<i>4th-5th Grade</i>) • Provide details to support opinions (<i>4th-5th Grade</i>) • Present events or thoughts in a logical sequence (<i>4th-5th Grade</i>) • Provide necessary background information (<i>4th-5th Grade</i>) • Use appropriate language, maintain eye contact, and use visual supports (<i>4th-5th Grade</i>) • Respond appropriately to audience reactions and questions (<i>4th-5th Grade</i>) • Read grade-level material aloud; speak with fluency and proper emphasis (<i>3rd Grade...</i>)		
Students understand, analyze, evaluate, and respond effectively to oral presentations.	Students... • Listen to teacher and student presentations. They will.... - identify the speaker's purpose (<i>4th/5th Grade</i>) - identify key ideas and supporting details (<i>4th/5th Grade</i>) - distinguish fact from opinion, interpretation, assumption, or belief (<i>4th/5th Grade</i>) - draw their own conclusions (<i>4th/5th Grade</i>) - identify important questions that emerge from the presentation (<i>4th/5th Grade</i>) • In discussions, students will: - ask key questions for clarification and additional information (<i>3rd Grade...</i>) - exchange ideas and opinions (<i>3rd Grade...</i>) - use language and behaviors that are polite and respectful (<i>3rd Grade</i>) - Students will also be able to: - summarize and paraphrase the previous speakers' key points		

- STRAND #5 - RESEARCH, STUDY SKILLS, AND TECHNOLOGY

Standard	3rd Grade	4th Grade	5th Grade
Students employ effective research and study skills.	Students... • Follow and give directions, of increasing complexity (<i>3rd-5th Grade</i>) • Ask questions and ask for help until they get the answers and information they need • Request information in writing, by telephone, in person (<i>3rd Grade</i>), and on-line (<i>4th/5th Grades</i>) • Take simple notes on readings and presentations, and construct simple outlines (<i>5th Grades</i>) • Keep a notebook for all notes and to organize and collect assignments (<i>4th/5th Grades</i>) • Alphabetize (up to six items, some with same first three letters; <i>3rd Grade</i>; words with the same first four letters; <i>4th Grade</i>; lists of random words and names; <i>5th Grade</i>) • Organize information in categories, rank order, and label groups accordingly (<i>continued from previous grades</i>) • Use book covers, title pages, tables of contents (<i>continued from previous grades</i>), and indexes (<i>4th-5th Grade</i>), to get information • Locate books in the school and other public libraries; using signs, layout maps, card and computerized catalogues (<i>4th Grade</i>) • Use reference sources; paper, on-line and CD-ROM, including encyclopedias (<i>3rd Grade</i>) • Identify and use additional sources of information outside of school (<i>3rd Grade...</i>)		

- STRAND #6 - VIEWING

Standard	3rd Grade	4th Grade	5th Grade
Students understand, analyze, evaluate, and respond effectively to visual presentations.	Students... • Retell the story: plays, television programs, movies, and other productions (<i>3rd Grade</i>) • Identify the intended messages of illustrations, plays, TV programs, and advertisements (<i>3rd Grade</i>) • Identify and consider reasons for selecting or rejecting particular plays, television programs, movies, and other productions (<i>4th Grade</i>)		

- STRAND #7 - SOCIAL SKILLS: PERSPECTIVE-TAKING & CONFLICT-RESOLUTION

Standard	Kindergarten 1-2	1st - 2nd Grade	3rd - 5th Grade
Students understand and express different points of view.	Students: • use "I" to express their point of view • express their own feelings and reasons • describe their own words and actions, and those of other people	Students: • use "you" to express another person's point of view • express the thoughts and feelings of another person • coordinate thoughts and feelings with words and actions • determine intentionality of actions	Students: • express another person's views of the their own viewpoints • describe complex and contradictory feelings • distinguish between appearances and inner reality
Students employ various conflict resolution strategies.	Students: • act unilaterally to resolve a conflict when another person won't listen (e.g., walk away, take time out, defend themselves)	Students: • use impartial rules to resolve conflicts and acknowledge they have to coordinate their actions with those of others (e.g., take turns, flip a coin, throw fingers)	Students: • use reason to try to convince other people of their positions • listen sincerely to other people

Student Requirements: English Language Arts, Third Grade

By the close of the third grade, students will successfully complete the following products for inclusion in their portfolio*. Teachers are encouraged to combine these with other products from other subject areas:

- **Reading Reviews:** Students read, understand, and review at least twenty books (fiction and non-fiction) and at least ten other selections (poems, articles, magazines, newspapers, etc.). Students should review works from their reading series, seven works from the Voices of Love and Freedom program, and other selections they read in school, at home, or on their own. Students' selections will include traditional and contemporary literature from at least five different authors (male and female), various genres, and at least three different cultures. To demonstrate understanding of each selection, students will respond, orally or in writing. Their response may include the following:

- a summary of the work;
- a description of a selected character;
- an illustration;
- a personal response to the work;
- answers to one or more "key questions" (see "Content Objectives")

Each student keeps a literature notebook including each of his/her written reading reviews. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Theme & Author Study:** Students explore two works that focus on a common theme or written by a single author, and compare and contrast these two works, including the characters, the story structure, and the author's use of language. The students' product will include written work, illustrations, and a story map.
- **Autobiography:** Students describe an important event in their lives, orally and/or in writing, that relates to a particular theme or goal from a book that has been read in class. They describe the thoughts and feelings of the other persons in the story as well as their own. The product can include written work, pictures, drawings, photos or other works of art.
- **Essay - My Point of View:** Students will present their point of view on a theme, goal, or problem of importance to them, and give two or more reasons why they selected this point of view.
- **Letter - Responding to a Recipient's Letter:** Students write (and send) a neat, legible, well-organized letter to a classmate, friend, relative or guest reader in which they describe their thoughts and feelings about a selected theme, topic, book, or event and ask what the recipient's viewpoint is about the same theme, topic, book, or event. They respond to the recipient's return letter by commenting on the recipient's point of view about that theme, topic, or book.
- **Literature Circles/Recitation:** Students participate in frequent literature circles. They discuss story structure: theme, characters, problems and solutions, and their own response to the work. Students recite a favorite poem or passage from memory.
- **Inquiry Project:** Students record weekly observations of changes in some person, place, or thing; they share their observations with others.
- **Original Work:** Students write or present an original narrative or descriptive work (e.g. adaptation/ innovation, picture book, poem, song; description of a friend, family member, or scene). Students present their work in class and discuss it with classmates.
- **Perspective Taking Exercise - Your View of Me:** Students, working in pairs, share personal experiences related to a selected theme or goal from a book they have read in class. Next, each student stands in front of the class "in his or her own shoes" and expresses someone else's view of him or herself. Then, standing in that other person's shoes, the student expresses what that person thinks the student's view is of him or her. The emphasis for grades three through five is on coordinating different points of view.
- **Conflict Resolution Exercise - Using Persuasion:** Students discuss a conflict from one of their books with their partners and then roleplay, illustrate, or write about how they would resolve the conflict. The students use the Ask, Brainstorm, Choose (ABC) approach to conflict resolution, with an emphasis on persuasion strategies, e.g., you are persuaded, or you

persuade the other person. The emphasis for grades three through five is on learning to use persuasion to solve conflicts. (see Voices of Love and Freedom Teacher Guides for additional directions)

- * All students will complete Reading Reviews during the 1996-97 school year. In addition, teachers, working together by grade level or school, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, or conflict-resolution; and one product that focuses on writing, that all students in that grade or school will complete during the 1996-97 school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Student Requirements: English Language Arts, Fourth Grade

As a condition of subject completion, students must.....

- Complete all subject requirements, as outlined by the teacher.
 - Pass the citywide Curriculum Test for the subject (not a requirement in 1996-97).
 - Successfully complete the following, for inclusion in their portfolio*.
- (Teachers are encouraged to combine these with other products from other subject areas.)

- **Reading Reviews:** Students read, understand, and review four books, and at least ten other selections (poems, short stories, articles, plays, etc.), in depth. The books will include literature from at least three different cultures. The other selections will include traditional and contemporary works from at least five different writers (male and female), five genres, and a variety of cultures. To demonstrate understanding of the books (and other selections), students will write their personal reflections on the books, personal questions that have emerged, and answers to the following "key questions":

- How does the author use language and/or illustrations to make the story interesting?
- How are you most like or different than the main character?
- What challenges did the main character have to face?
- How are some of the events like experiences you have had?
- How would you change the ending of this story?
- What lessons did you learn from this story?
- Would you recommend this book to someone else? Why or why not?

(Note: Teachers will select particular key questions students will answer for each book. Students must *be able to* answer all of these questions for each book. Additional book-specific key questions are being written for those books included on the Core Literature list.)

Each student keeps a literature notebook for their required readings. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Autobiography:** Students describe, in writing, an important event in their lives, related to a theme or goal from a book they are reading. They relate the event as a story, with characters (including themselves), a setting, and a beginning, middle, and end. They describe their thoughts and feelings, and those of one other person. The students also discuss what they learned from the event. The product may include pictures, drawings, photos, or other works of art.
- **Essay - My Point of View:** Students write an essay of two or more paragraphs on a theme, goal, or problem they discuss with a partner. The essay should include a definition of the issue, and provide reasons to support alternative positions, including their own.
- **Letter - Comparing Points of View:** Students write (and send) a neat, legible, well-organized letter to a classmate, friend, relative or guest reader in which they describe their thoughts and feelings about a selected theme, topic, or book and ask what the recipient's viewpoint is about the same. They respond to the recipient's return letter by comparing and contrasting their own and the recipient's points of view on that theme, topic, or book.
- **Literature Circles/Recitation:** Students participate in frequent literature circles. They participate in discussions of themes, characters, story structure, and their own perspective on the work. Students recite a favorite poem or passage, from memory.
- **Theme & Author Study:** Students explore two works that focus on a common theme, person, or event, written by different authors. They compare and contrast the two works. The students' product will include written work, illustrations, and a story map.
- **Original Work:** Students write or present an original narrative or descriptive work (e.g., adaptation/innovation, picture book, poem, song; description of a friend, family member, or scene). Students present their work in class and discuss it with classmates.

- **Perspective Taking Exercise - The Point of View of Someone You Disagree With:**

Students interview another student who has taken a very different position on a school or classroom policy. After they both understand each other's points of view, including facts supporting each of them, they will stand in front of the class in the shoes of the person they disagree with and express the other person's points of view.

- **Conflict Resolution Exercise - Persuading Someone Who Disagrees With You:** After standing in each other shoes, the two students use the Ask, Brainstorm, Choose (ABC) approach to try to resolve the problem, with a particular emphasis on trying to persuade each other of their respective positions. (see Voices of Love and Freedom Teacher Guides for additional directions)

- * All students are expected to complete Reading Reviews during the 1996-97 school year. In addition, teachers, working together by grade level or school, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, or conflict-resolution; and one additional product that focuses on writing, that all students in that grade or school will successfully complete during the 1996-97 school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Student Requirements: English Language Arts, Fifth Grade

As a condition of completing the subject, students must.....

- Complete all subject requirements, as outlined by the teacher.
 - Pass the citywide Curriculum Test for the subject (not a requirement in 1996-97).
 - Successfully complete the following, for inclusion in their portfolio*.
- (Teachers are encouraged to combine these with other products from other subject areas.)

- **Reading Reviews:** Students read, understand, and review four books, and at least ten other selections (poems, short stories, articles, plays, etc.), in depth. The books will include literature from at least three different cultures. The other selections will include traditional and contemporary works from at least five different writers (male and female), five genres, and a variety of cultures. To demonstrate understanding of the books (and other selections), students will write their personal reflections on the books, personal questions that have emerged, and answers to the following "key questions":

- How does the author use language and/or illustrations to make the story interesting?
- How are you most like or different than the main character?
- What challenges did the main character have to face?
- How are some of the events like experiences you have had?
- How would you change the ending of this story?
- What lessons did you learn from this story?
- Would you recommend this book to someone else? Why or why not?

(Note: Teachers will select particular key questions students will answer for each book. Students must *be able to* answer all of these questions for each book. Additional book-specific key questions are being written for those books included on the Core Literature list.)

Each student keeps a literature notebook for their required readings. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Autobiography - Elementary School Experiences:** Students describe two or three experiences from elementary school that had a particularly important impact on them. They describe their own thoughts and feelings about these experiences, plus the thoughts and feelings of others. They describe a conflict or turning point in their lives. Students may complement their written work with pictures, drawings, photos, or other works of art.
- **Essay - A Neighborhood Problem:** Students write an essay of three or more paragraphs on a controversial issue in their neighborhoods. The essay should define the conflict, explore various options for solving the conflict, provide arguments for each option, select the best option, and provide a convincing argument for the option chosen.
- **Letter - A Protest:** Students write (and send) a letter to a public figure sharing their opinions on a particular issue and asking that person particular questions they'd like her/him to respond to. When (if) each student receives a response, the student responds with a thank you letter in which s/he comments on that person's response.
- **Presentation:** Students present their response to a "key question" related to one of the required readings, including a particular reference to the literature. The presentation will kick-off a discussion of that question by the class. As a part of the presentation, students recite a favorite line or brief passage, from memory, and explain their reasons for selecting it.
- **Research Paper:** Students complete a research paper on a selected theme or topic. They read at least two works on the topic and gather any additional information they can find. The paper is designed to introduce students to the research process, teach them how to organize large quantities of information, improve their library skills, and expose them to a variety of sources and materials.
- **Original Work:** Students write an original narrative or descriptive work (e.g. adaptation/innovation, picture book, poem, song; description of a friend, family member, or scene). Students present their work in class and discuss it with classmates.

- **Perspective Taking Exercise - Your Friend's View of an Issue or Problem:** Students share with their partners their views about what they think their friends think about a particular issue or problem. Next, standing in front of the class "in their own shoes", they will express their friends' views. Then, standing in their friends's shoes, they express how that person thinks the student views the issue or problem, in turn.
- **Conflict Resolution Exercise - Using Persuasion Among Friends:** Students discuss a conflict from one of their books with their partners and then roleplay, illustrate, or write about how they would resolve the conflict. Students use the Ask, Brainstorm, Choose (ABC) approach to conflict resolution, with an emphasis on persuasion strategies, e.g., you are persuaded, or you persuade the other person. (see Voices of Love and Freedom Teachers Guides for additional directions)
- * All students are expected to complete Reading Reviews during the 1996-97 school year. In addition, teachers, working together by grade level or school, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, or conflict-resolution; and one additional product that focuses on writing, that all students in that grade or school will successfully complete during the 1996-97 school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives: Kindergarten-3rd Grade

Overview: Students will read, or have read to them, a variety of texts each day. Students will understand and discuss the topics, lessons, and structure of each text they read or listen to. They should be able to answer the key questions listed below for each of these works, as well as additional key questions particular to each work.

Core Literature: All of the works from the four reading series we've chosen, from the Voices of Love and Freedom, and from Literature is Tops, are included in our core literature for kindergarten through third grade.

Key Concepts: Students will explain the key topics, themes, and literary conventions that are central to the works they read (or have read to them), citing references to the literature and to personal experiences. The following example is for Steig's Brave Irene, a third grade book.

Topics: Determination

Literary Conventions: Fantasy/Realism; Elements of Fairy Tales; Personification

Themes*: Students will understand...

- the value of seeing a project through to the end, despite all obstacles;
- the important roles family members can play in supporting one another during difficult times.

*Theme: the key lesson(s) the author is trying to convey; the "moral to the story"; the author's position on the book's key topic(s)

Key Questions: Key questions are thought-provoking, often open-ended questions that stimulate students' development of a deep understanding of a work of literature (or other reading selection). Students will write and/or present insightful responses to each of the following key questions about the literature (or other selections) they read (or have read to them), citing references to the work, as well as their own experiences.

- How does the author use language and/or illustrations to make the story interesting?
- How are you most like or different than the main character?
- What challenges did the main character have to face?
- How are some of the events like experiences you have had?
- How would you change the ending of this story?
- What lessons did you learn from this story?
- Would you recommend this book to someone else? Why or why not?

Non-fiction key questions: (magazines, newspapers, chants, poems)

- What is the work about (topic)?
- Why did the author write about this work?
- What did you learn?
- What questions do you still have about the topic?
- Do you think other students would enjoy reading this? Why or why not?

In addition, teachers identify particular book/selection-specific "key" questions that are open-ended, thought-provoking and engaging to students, that are essential to developing a deep understanding of the major themes or ideas in the reading. Teachers select particular key questions students will respond to for each selection, from those listed above, from others they have developed, and from additional questions students are interested in. The following example of key questions is for Steig's Brave Irene.

- Is this a real story or a fairy tale? In what ways is it real? In what ways is it a fairy tale?

- What words would you use to describe Irene?
- What do you think is the matter with Irene's mother?
- If you were in Irene's place, how do you think you would have acted and why?
- Do you think Irene would ever deliver anything in a snowstorm again? Why or why not?
- Would you like to have Irene for a friend? Why or why not?
- Should Irene's mother have allowed her to deliver the dress?
- What would be a good sequel to this story?

Content Objectives: English Language Arts, Fourth Grade

Overview: Students will discuss and understand the concepts, lessons, and structure of each of the stories, books, and poems they read. Students will reflect on the key concepts and lessons from the literature; deepen their understanding of literary conventions; make connections between the literature, their personal experiences, and the experiences of others; and complete a variety of products to share their new understandings with others.

Core Literature: A Core Literature list, including a single required book for each grade level, and additional recommended books differentiated by grade-level (to ensure that students are not reading the same books year after year), is included. Additional books will be added to the list next year.

A minimum of four complete books should be taught in English Language Arts each year. These four books should come from the Core Literature list by school year 1998-99 (or earlier, if funds can be identified to purchase these books for each school).

Key Concepts: Teachers should identify the key topics, themes, and literary conventions included in each book the students read. Students should be able to explain these topics, themes, and conventions, citing examples from the literature and personal experiences. (The following sample is for Namioka's Yang the Youngest and His Terrible Ear, a book included on the Core Literature list for the 4th grade.)

Topics: Self-Realization; Friendship; Immigration

Literary Conventions: Characterization; Humor; Descriptive Phrases; Words with Multiple Meanings

Themes*: Students will understand...

- that family members who work together can achieve their goal
- that it is important to involve your parents in making your decisions
- the challenges faced when moving to a new country
- the importance of recognizing their strengths

***Theme:** the key lesson(s) the author is trying to convey; the "moral to the story"; the author's position on the book's key topic(s)

Key Questions: Key questions are thought-provoking, often open-ended questions that stimulate students' development of a deep understanding of a work of literature or other reading selection. Students will write and/or present insightful responses to the following key questions about the selections they read, citing references to the work and their own experiences. Teachers may select particular questions to emphasize for each work the students read.

Fiction/Biography/Autobiography:

• Topic:

What is this book/chapter all about?

- **Theme:** the key lesson(s) the author is trying to convey; the "moral of the story"; the author's position on the book's key topic(s). Example: "Topic": Friendship; "Theme": Friendship has obligations.

What lessons is the author trying to teach?

How does the theme apply to your life?

Do you agree or disagree with the author's point of view?

• Plot:

What are the most memorable or significant events? Why these?

What role did they play in developing the theme?

What's going to happen next? Did it?

• Characterization:

Who are the most important characters? What makes them so important?

How do they help to develop the theme?

What are their key characteristics?

• Conflict:

What challenges are the key characters wrestling with?

How are they responding to them?

How should they respond? How would you respond?

- **Setting:**
How do location, time, and culture affect the characters and plot?
What role do they play in developing the theme?
Would the story be different in another location, time, or culture?
- **Language:**
How does the author's use of language enhance the story?
- **Connections:**
What comparisons can you make between characters and events in the book/chapter, yourself, and contemporary characters/events you're familiar with?
- **Significance:**
Why is this book important?
Is there anything unique about this book? Is there anything difficult or challenging?
Would you recommend this book to a friend? Why or why not?
- **General:**
What are the most interesting things you learned?
What surprised or amazed you?
How would you change any part of this chapter? How would this change affect the story?

Non-Fiction (Articles/Editorials/Essays/Speeches et al.):

- **Purpose**
What is the author's purpose?
- **Topic**
What is the main topic?
- **Point of View**
What is the author's point of view?
How well does the author present and support his/her point of view?
What facts, opinions, assumptions, interpretations, and/or beliefs does s/he present?
- **Credibility**
Is the author believable?
What important questions remain unanswered?
- **General**
What did you learn?
Would you recommend this reading to someone else? Why or why not?

In addition, teachers should identify particular book/selection-specific "key" questions that are open-ended, thought-provoking and engaging to students, and essential to developing a deep understanding of the major themes or ideas in the reading. Teachers should select particular key questions students will respond to for each selection they read, from those listed above, from others they have developed, and from additional questions students are interested in.

The following sample of some book-specific key questions is also for Namioka's Yang the Youngest and His Terrible Ear.

- How are the two friends, Yingtao and Matthew alike? How are they different? (Use a Venn diagram for your answers.) Do the two boys have a lot in common or are they very different?
- Why can't Yingtao pursue his interest in baseball? How does he solve his problem?
- Will Yingtao get homesick for China? Give two reasons why you chose your answer.
- Why do you think Third Sister decided to knock over the screen? Would you have done the same thing? Explain your answer.
- How do American customs differ from Chinese traditions? Use references from the book in your answer.
- If Matthew had not played the violin behind the screen, how might the story have changed?

Content Objectives: English Language Arts, Fifth Grade

Overview: Students will discuss and understand the concepts, themes, and structure of each of the stories, books, and poems they read. Students will reflect on the key concepts and lessons from the literature; deepen their understanding of literary conventions; make connections between the literature, their personal experiences, and the experiences of others; and complete a variety of products to share their new understandings with others.

Core Literature: A Core Literature list, including a single required book for each grade level, and additional recommended books differentiated by grade-level (to ensure that students are not reading the same books year after year), is enclosed. Additional books will be added to the list next year.

A minimum of four complete books should be taught in English Language Arts each year. These four books should come from the Core Literature list by school year 1998-99 (or earlier, if funds can be identified to purchase these books for each school).

Key Concepts: Teachers should identify the key topics, themes, and literary conventions for each book a student reads. Students should be able to explain the topics, themes, and conventions, citing examples from the literature and personal experiences. (The following sample is for *Bette Bao Lord's In the Year of the Boar and Jackie Robinson*, a book on the Core Literature list for the fifth grade.)

Topics: Friendship, Immigration, the American Dream

Literary Conventions: Dialogue, Characterization, Imagery, Humor, Personification, Simile

Themes*: Students will understand...

- having a common interest often brings people together.

*Theme: the key lesson(s) the author is trying to convey; the "moral to the story"; the author's position on the book's key topic(s)

Key Questions: Key questions are thought-provoking, often open-ended questions that stimulate students' development of a deep understanding of a work of literature or other reading selection. Students will write and/or present insightful responses to the following key questions about the selections they read, citing references to the work and their own experiences. Teachers may select particular questions to emphasize for each work the students read.

Fiction/Biography/Autobiography:

- **Topic:**

What is this book/chapter all about?

- **Theme:** the key lesson(s) the author is trying to convey; the "moral of the story"; the author's position on the book's key topic(s). Example: "Topic": Friendship; "Theme": Friendship has obligations.

What lessons is the author trying to teach?

How does the theme apply to your life?

Do you agree or disagree with the author's point of view?

- **Plot:**

What are the most memorable or significant events? Why these?

What role did they play in developing the theme?

What's going to happen next? Did it?

- **Characterization:**

Who are the most important characters? What makes them so important?

How do they help to develop the theme?

What are their key characteristics?

- **Conflict:**

What challenges are the key characters wrestling with?

How are they responding to them?

How should they respond? How would you respond?

- **Setting:**

How do location, time, and culture affect the characters and plot?

What role do they play in developing the theme?

Would the story be different in another location, time, or culture?

- **Language:**
How does the author's use of language enhance the story?
- **Connections:**
What comparisons can you make between characters and events in the book/chapter, yourself, and contemporary characters/events you're familiar with?
- **Significance:**
Why is this book important?
Is there anything unique about this book? Is there anything difficult or challenging?
Would you recommend this book to a friend? Why or why not?
- **General:**
What are the most interesting things you learned?
What surprised or amazed you?
How would you change any part of this chapter? How would this change affect the story?

Non-Fiction (Articles/Editorials/Essays/Speeches et al.):

- **Purpose**
What is the author's purpose?
- **Topic**
What is the main topic?
- **Point of View**
What is the author's point of view?
How well does the author present and support his/her point of view?
What facts, opinions, assumptions, interpretations, and/or beliefs does s/he present?
- **Credibility**
Is the author believable?
What important questions remain unanswered?
- **General**
What did you learn?
Would you recommend this reading to someone else? Why or why not?

In addition, teachers should identify particular book/selection-specific "key" questions that are open-ended, thought-provoking and engaging to students, and essential to developing a deep understanding of the major themes or ideas in the reading. Teachers should select particular key questions students will respond to for each selection they read, from those listed above, from others they have developed, and from additional questions students are interested in.

The following sample of some book-specific questions is for Bette Bao Lord's In the Year of the Boar and Jackie Robinson.

- How could you use a character map to describe Bandit?
- What problem does Shirley have adjusting to America?
- Why do you think Shirley has difficulty making friends?
- How does Shirley's interest in baseball affect her life?
- What does Shirley learn about the meaning of friendship?

**Boston Public Schools
Core Literature List, 1996-97
English Language Arts**

Grade 4

1. Yang the Youngest and His Terrible Ear* - Namioka
2. Abel's Island - Steig
3. Charlotte's Web - White
4. Koya Delaney and the Good Girl Blues - Greenfield
5. My Name is Maria Isabel - Ada
6. Sarah, Plain and Tall - McLachlan
7. Sadako and the 1000 Paper Cranes - Coerr
8. Song of Trees - Taylor
9. The Fighting Ground - Avi
10. The Hundred Dresses - Estes
11. The Magic Shell - Mohr
12. A Boy Becomes a Man at Wounded Knee - Wood

Grade 5

1. Mississippi Bridge* - Taylor
2. Dear Mr. Henshaw - Cleary
3. Felita - Mohr
4. In the Year of the Boar and Jackie Robinson - Lord
5. Journey to Jo'burg - Naidoo
6. Kid in the Red Jacket - Park
7. Crossing the Starlight Bridge - Mead
8. Onion Tears - Kidd
9. Pride of Puerto Rico - Walker
10. Shiloh - Naylor
11. Sojourner Truth, "Ain't I a Woman?" - McKissick
12. Starfisher - Yep
13. The Real Thief - Steig

Grade 6

1. Gift Giver* - Hansen
2. Roll of Thunder, Hear My Cry - Taylor
3. So Far from the Bamboo Grove - Kawashima Watkins
4. Clay Marble - Fong Ho
5. Number the Stars - Lowry
6. Bridge to Terabithia - Paterson
7. Maniac Magee - Spinelli
8. Going Home - Mohr
9. Taking Sides - Soto
10. Guests - Dorris

Grade 7

1. Let the Circle be Unbroken* - Taylor
2. Young Landlords - Myers
3. Taste of Salt - Temple
4. Dragonwings - Yep
5. Goodbye, Vietnam - Whelan
6. Homecoming - Voight
7. Monkey Island - Fox
8. Grab Hands and Run - Temple
9. Among the Volcanoes - Castaneda
10. When Thunders Spoke - Sneve
11. Scorpions - Myers

Grade 8

1. The Giver* - Lowry
2. Hoops - Myers
3. Year of Impossible Goodbyes - Nyul Choi
4. Dragon's Gate - Yep
5. Children of the River - Crew
6. Dicey's Song - Voight
7. Journey of the Sparrows - Buss
8. Lyddie - Patterson
9. Growing Up Inside the Sanctuary of My Imagination - Mohr
10. High Elks Treasure - Sneve
11. Road to Memphis - Taylor
12. Harriet Tubman - Petry

Grade 9

1. A Raisin in the Sun* - Hansberry
2. Narrative of the Life of Frederick Douglass - Douglas
3. Romeo and Juliet - Shakespeare
4. Animal Farm - Orwell
5. The Miracle Worker - Gibson
6. Of Mice and Men - Steinbeck
7. Annie John - Kincaid
8. April and the Dragon Lady - Namioka
9. One Bird - Mori
10. Bless Me, Ultima - Anaya
11. Jesse - Soto
12. Night Flying Woman - Broker

Grade 10

1. Night* - Weisel
2. Black Boy - Wright
3. Antigone - Sophocles
4. To Kill a Mockingbird - Lee
5. The Fire Next Time - Baldwin
6. The Friends - Guy
7. Flowers for Algernon - Keyes
8. Teacup Full of Roses - Mathis
9. Rice Without Rain - Ho
10. The Honorable Prison - de Jenkins
11. The House on Mango Street - Cisneros
12. Mountain Windsong - Conley
13. Smoke Rising - Bruchac
14. Farewell to Manzanar - Wakatsuki Houston

* 1996-97 Citywide Required Reading

**Boston Public Schools
Core Literature List, 1996-97
English Language Arts
(continued)**

Grade 11

1. I Know Why the Caged Bird Sings* - Angelou
2. Their Eyes Were Watching God - Hurston
3. The Crucible - Miller
4. The Piano Lesson - Wilson
5. Death of a Salesman - Miller
6. The Scarlett Letter - Hawthorne
7. My Antonia - Cather
8. China Boy - Lee
9. The Joy Luck Club - Tan
10. An Island Like You - Ortiz Cofer
11. In Nueva York - Mohr
12. Love Medicine - Erdrich

Grade 12

1. Hamlet* - Shakespeare
2. The Autobiography of Malcom X - Haley
3. Oedipus, the King - Sophocles
4. Song of Solomon - Morrison
5. Incidents in the Life of a Slave Girl - Jacobs
6. The Women of Brewster Place - Naylor
7. Frankenstein - Shelley
8. Love, Stars and All That - Narayan
9. In the Time of the Butterflies - Alvarez
10. Ceremony - Marmon Silko
11. The Grass Dancer - Power
12. The House of the Spirits - Allende

* 1996-97 Citywide Required Reading

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**Mathematics
Kindergarten-Fifth Grade**

**Version 96.1
June 28, 1996**

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BPS Learning Standards and Curriculum Framework: Mathematics

Introduction:

This document is a guide to the Boston Public Schools mathematics standards. The standards are designed to create consistency and continuity across the grade levels, set parameters for the designation of instructional time, and most importantly, improve the mathematics education of all students in the Boston Public Schools.

Guiding Principles:

There are underlying beliefs and tenets that are central to the vision of mathematical power and the content standards for mathematics education:

- Students should explore mathematical ideas in ways that maintain their enjoyment of and curiosity about mathematics, help them develop depth of understanding, and reflect real-world applications.
- All students should have access to a high quality mathematics program.
- Mathematics learning is a lifelong process that begins and continues in the home and extends to the school and community settings.
- Mathematics instruction should make connections with other disciplines, within mathematics, and to real-world situations.
- Working together in teams and groups enhances mathematical learning, helps students communicate effectively, and develops social and mathematical skills.
- Technology is an essential tool for effective mathematics education.
- Mathematics assessment is a multifaceted tool that monitors student performance, improves instruction, enhances learning, and encourages student self-reflection.

(1996 Massachusetts Mathematics Curriculum Framework)

Core Processes:

The Boston Public Schools Citywide Learning Standards for Mathematics build upon the Massachusetts Mathematics Curriculum Framework's core concept that students develop mathematical power through problem-solving, communication, reasoning, and connections.

These concepts are elaborated on further at the beginning of the PreK-5 and 6-9 Learning Standards.

- Problem Solving: Problem solving is the central focus of mathematics education. Whenever we apply our mathematics knowledge, skills, or experiences to the resolution of a dilemma or situation that is new or perplexing, we are problem solving.
- Communication: Students learn mathematics best when they talk and write about what they are doing. Communication in mathematics promotes mathematical understanding and creates mathematical power.
- Reasoning: Mathematics reasoning is necessary if we are to know and do mathematics. The ability to reason enables students to solve problems in their lives, in and outside of school. Students need to be provided with opportunities to make conjectures, think about and select sensible ways to solve problems, justify their solutions, and share their reasoning with others. They also need to experience, recognize, learn, and use different types of reasoning.
- Connections: Mathematics topics are connected to real life and to one other. Students should understand how mathematics relates to other subject areas. For example, all students should understand the concepts of location and place, each of which is important to both geography and mathematics. Students should appreciate that mathematics is one way of learning about the world, and that it is connected, not isolated, from other ways of learning. Students need to see that many problems in the world, when examined initially, appear quite different; but when we model these same problems mathematically, they have striking similarities.

Organizational Structure:

Our standards are organized by "strands" that are included in the Massachusetts Curriculum Frameworks. These strands include:

1. Number Sense
2. Patterns, Relations, and Functions
3. Geometry, Spatial Sense, and Measurement
4. Probability, Statistics, and Discrete Mathematics

This organization promotes an "integrated" approach to mathematics.

Integrated Mathematics:

An integrated approach to teaching mathematics means making connections within mathematics, as well as to other disciplines and real world situations. In an "integrated mathematics" program, students are taught increasingly sophisticated concepts from different strands of mathematics, including arithmetic, algebra, geometry, probability, and statistics. Measurement is related to number, data, and geometry; and algebraic ideas of patterns and relationships are developed in all areas of mathematics. This process begins in the early grades and continues throughout high school.

Students learn to solve real-life problems that require the integration of skills from two or more of these mathematics strands. Skills, concepts, and procedures are taught through authentic tasks as an integrated whole, not in isolation of one another. Concepts are taught over a long period of time, and connected to a variety of strands.

For example, the concept of fractions should be explored and taught a number of times throughout the school year:

- as parts-to-whole (geometry)]
- as the comparison of two quantities (number sense, ratio)
- as the comparison of a particular quantity with a fixed quantity (decimals and percent)
- as the comparison of two comparisons (ratio and proportion)
- through the application of fractions as rates one can investigate (probability and statistics)

When students are exposed to and use fractions in the many ways they are commonly used in the real world, they can become far more proficient problem-solvers.

Beginning in 1998, students throughout Massachusetts will take statewide assessments in mathematics. These assessments will reflect the integrated approach adopted by the state. We are aligning our standards with this approach to prepare our students for these assessments.

Finally, the integrated approach is not new. In most European countries, mathematics is taught in an integrated manner. For example, there is no artificial separation of algebra and geometry. By the same token, math instruction in many of our classrooms is already integrate. Effective teachers, particularly at the elementary and middle school levels, have been using an integrated approach to mathematics instruction for years. For example, even very young children begin to study shapes and sizes during the primary grades, though the language of geometry may not be used. Many Boston middle schools already introduce algebra concepts through an integrated approach. All of this work will continue, and be supported by an integrated approach across all levels.

Key Characteristics:

The following principles define our standards' key characteristics.

- Accessible: Our standards are accessible to the children in the Boston Public Schools.

- **Rigorous:** Our standards are challenging. In addition to requiring the mastery of facts and procedures, we expect students to know the meaning of computation and operations. Students are required to move beyond the intuitive and concrete level of understanding, to the representational, abstract, application, and communication levels. Mastery is achieved only when a student is able to communicate his or her learning.
- **Meaningful:** Our standards require students to make meaningful connections between their classroom and the world outside of school. The standards demonstrate to students that learning mathematics is a life-long process, and its purpose is to solve real problems.
- **Inquiry-Centered:** Our standards promote experiences that are exploratory and discovery-oriented. Students should be encouraged to persist and take risks, be actively engaged, and feel confident in their ability to do mathematics. Though students will make many mistakes along the way, we view these mistakes as opportunities to learn, particularly when they are discussed with other students and the teacher.
- **Communication and Reflection-Centered:** Mathematics is a language to be learned, with its own vocabulary, syntax, and rules of translation from language to symbol (and vice-versa). We expect students to explore and reflect on concepts and procedures, to express their mathematics understandings clearly, through speech and writing, and to develop their reading skills, as related to mathematics.
- **Student Focused/Appropriately Paced:** Some students need more time to master the concepts included in our standards. Our standards framework responds to these needs. Every student will graduate with a solid foundation in arithmetic, algebra, geometry, probability, and statistics. Some students will also graduate with a solid foundation in calculus.
- **Concrete:** Our standards provide teachers and students with concrete example of problems, tasks, and products students will be expected to solve and complete.
- **Assessment-Embedded:** Assessment is an integral part of the mathematics program, and is aligned with curriculum and instruction. A variety of methods such as performance tasks, projects, observations, discussions, writings, etc. are used to measure and monitor student performance, enhance learning, and improve instruction.

Mathematics assessment also encourages student reflection. Students are expected to take increasing responsibility for organizing and extending tasks into projects and long-term activities. They will select and organize mathematics and resources, extend work to related tasks, review their progress, and check and evaluate their work. Throughout this process, students will develop confidence, perseverance, and persistence by continuing to work on problems that pose challenges.

- **Technological:** Our standards require students to understand and use appropriate instructional technology, including calculators, computer software, graphing utilities, statistics packages, and different types of measuring devices, to enhance and accelerate mathematics learning, to represent and communicate mathematical ideas, and to make mathematics more accessible to all children. Appropriate technologies will be used in the spirit of manipulatives to make presentations, carry out explorations, and assess mathematical concepts and skills.
- **Open-Ended:** As children need more and more mathematics to be successful in life, as we learn more about the way children learn mathematics, and as instructional methodologies get better, our standards and curriculum need to keep pace with these changes. Our standards are designed to be implemented, reviewed, and revised, as needed, on an ongoing three to five year cycle.

Core Processes: Mathematics Grades K-5

Problem Solving: Problem-solving is not a distinct topic, but a process that should permeate the entire program and provide the context in which concepts and skills can be learned. (NCTM)

Students will...

- form and solve problems using multiple approaches
- work with math manipulatives in a variety of ways
- verify and interpret results
- work out ways to overcome their difficulties
- organize and check their work
- search for patterns while working with numbers, data, shapes, and objects in their environment
- sort, classify, and make comparisons
- use calculators and computers to generate and explain number
- apply mathematics to practical tasks and real-life problems
- gain confidence in solving math problems

Communication: All students should develop and present conclusions through speaking, writing, artistic, and other means of expression. (Massachusetts Common Core of Learning)

Students will...

- express mathematical ideas, skills, and discoveries through demonstration, drawing, writing, and talking
- relate everyday language to mathematical language and symbols
- work together to create and solve problems
- exchange problems with each other
- justify their own reasoning about mathematics
- record and present their work in a variety of ways
- discuss their work, responding to and asking critical questions such as:
 - What would happen if? Why?
 - What is the pattern? Can this be solved or expressed another way?

Reasoning: If we would guide by the light of reason, we must let our minds be bold. (Louis Brandeis)

Students will...

- make and evaluate mathematical conjectures and arguments
- think about and select sensible ways to solve problems
- justify solutions and explain the problem-solving process
- share their reasoning with others
- experience, recognize, learn, and use different types of reasoning

Connections: Students who are able to apply and translate among different representations of the same problem situation, or the same mathematical concept, will have at once a powerful, flexible set of tools for solving problems, and a deeper appreciation of the consistency and beauty of mathematics. (NCTM)

Students will...

- use mathematics skills in everyday life
- recognize the relationships among different topics in mathematics
- connect ideas within the curriculum strand and with other concepts they are learning
- work with appropriate technology in the development of concepts and skills

BPS Learning Standards: Kindergarten Mathematics

Strand #1: Number Sense

Number sense is the ability to understand and use numbers and operations on numbers in computation, measurement, and estimation situations. (NCTM Standards)

Number Sense, Numeration, and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Construct number meanings by using manipulatives, real world experiences, and other physical materials.	Objectives: Students... • develop a variety of approaches to working with numbers • work with manipulatives in a variety of models and forms
Standard #2: Understand our numeration system by relating counting, grouping, and place value.	Objectives: Students... • count objects to 20 (orally and mentally) • count, write, and compare numbers to twenty • count forward and backward from a given number (20 or less) • understand and use ordinal numbers • use, talk, and solve problems about numbers
Standard #3: Interpret multiple uses of numbers encountered in real world situations.	Objective: Students... • identify numbers in their environment
Standard #4: Understand the basic concepts of fractions, mixed numbers, and decimals.	Objective: Students... • identify and understand one-half
Standard #5: Apply estimation when working with quantities, computation, and measurement.	Objectives: Students... • begin to develop and discuss strategies for estimating quantities (1 - 20)

Number Sense, Computation, and Operations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop operation sense for whole numbers, fractions, and decimals.	Objectives: Students... • model and discuss the concrete representation of more and less • use groups of objects to compare and order numbers (one to one correspondence)
---	---

Number Sense, Computation, and Operations (continued)

Standard #2: Relate the mathematical language and symbolism of operations to problem situations.	Objectives: Students... • solve addition and subtraction problems (limited to numbers up to ten) using manipulatives, coins, patterns, relationships, and numbers • use the plus and minus signs
Standard #3: Identify a variety of problem structures that can be represented by a single operation.	Objectives: Students... • explore and apply addition and subtraction in a wide variety of contexts
Standard #4: Model, explain, and develop proficiency with basic facts and algorithms.	Objectives: Students... • understand and demonstrate a knowledge of joining and separating groups
Standard #5: Use calculators in appropriate computation situations.	Objectives: Students... • understand the grade-appropriate processes calculators perform • use calculators to facilitate problem-solving and other mathematical work
Standard #6: Model and understand equivalency of fractions and their relationship to decimals.	Objectives: Students... • understand and demonstrate the equivalency of one-half and fifth cents

Number Sense and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop and apply number theory concepts.	Objectives: Students... • use a variety of concrete materials to demonstrate number relationships
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Number Sense and Discrete Math:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Explore discrete mathematics concepts.	Objectives: Students... • recognize and complete pattern sequences (number, geometric, physical) • complete maze patterns
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Strand #2: Patterns, Relations, and Functions:

The study of patterns supports children in learning to see relationships, to find connections, and to make generalizations and predictions. (NCTM Addenda - Kindergarten)

Patterns and Relations: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Identify, describe, extend, and create a wide variety of numerical and geometric patterns.	Objectives: Students... • identify, extend, and create patterns in many forms • recognize and describe patterns in daily life (rhymes, music, calendar)
Standard #2: Represent and describe mathematical relationships.	Objectives: Students... • match written symbols to objects, numbers, quantity and words
Standard #3: Explore the use of variables and open sentences to express relationships.	Objectives: Students... • recognize observable regular events and shapes and work with generalizable patterns to express relationships
Standard #4: Use patterns and relationships to represent, analyze, and solve mathematical problems.	Objectives: Students... • sort, classify, make comparisons and search for patterns while working with data and numbers

Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Formulate and write number sentences for real problems.	Objectives: Students... • use coins, manipulatives, numbers, and patterns in number sentence forms
Standard #2: Explain strategies used in finding missing components in patterns, sequences, and numbers.	Objectives: Students... • identify a missing piece of a physical and geometric pattern • identify missing numerals in a sequence or arrangement
Standard #3: Use concrete materials to understand maintaining balances in number sentences.	Objectives: Students... • apply commutative property of addition by: discussing real life experiences (comb my hair and brush my teeth/brush my teeth and comb my hair); use manipulatives; derive arithmetic facts using concrete objects (3+3 and 3+2)

Algebra (continued)

Standard #4: Explore and explain the use of variables in a number sentence.	Objectives: Students... • use tiles to represent a variable in a number sentence
--	---

Strand #3: Geometry and Measurement

Geometry and measurement help us represent and describe, in an orderly fashion, the world in which we live. (NCTM Standards & MA Mathematics Curriculum Framework)

Geometry and Spatial Sense: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, name, model, draw, and classify two-dimensional and three-dimensional shapes and figures.	Objectives: Students... • identify similarities and differences in objects; sort and classify objects by color, size, and shape
Standard #2: Investigate and predict the results of combining, subdividing, and changing shapes.	Objectives: Students... • identify, name, and draw a square, circle, triangle, and rectangle
Standard #3: Develop spatial sense.	Objectives: Students... • recognize shape in different orientations • recognize and discuss line of symmetry in objects and pictures
Standard #4: Use geometric ideas to develop numerical and measurement ideas.	Objectives: Students... • understand examples of quantity, space, and shapes using real objects

Measurement: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Demonstrate the attributes of perimeter, area, volume, weight, capacity, time, temperature, angle, and money.	Objectives: Students... • compare and order objects by: size, length, width, height, and weight • estimate and use non-standard units to measure real objects • identify coins (penny, nickel, and dime) • use clocks to recognize time by the hour
Standard #2: Use the process of measuring and the concepts related to units of measure.	Objectives: Students... • choose a unit of measure and compare it to a real object and report the number of units

Measurement (continued)

Standard #3: Make and use estimates of measure.	Objectives: Students... • select a real object and estimate its weight, length, or height
--	--

Strand #3: Probability and Statistics

Statistics and probability are important links to other content areas, such as social studies and science. They also reinforce communication skills as children discuss and write about their activities and their conclusions. Within mathematics, these topics regularly involve the uses of number, measurement, estimation, and problem solving." (NCTM Standards)

Probability and Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Collect, organize, and describe data.	Objectives: Students... • collect, sort, organize, and describe data
Standard #2: Construct, read, and interpret displays of data.	Objectives: Students... • construct graph using real objects and pictures
Standard #3: Formulate and solve problems that involve collecting and analyzing data.	Objectives: Students... • use pictures to collect and analyze data to solve problems
Standard #4: Explore and describe concepts of chance.	Objectives: Students... • make predictions and discuss the likelihood of an event happening (always, sometimes, never) • understand examples of chance (heads/tails)

BPS Learning Standards: First Grade Mathematics

Strand #1: Number Sense

Children who have number sense understand how numbers relate to each other and furnish information about the world. (NCTM Standards, Grade 1 Addendum)

Number Sense, Numeration, and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Construct number meaning by using manipulatives, real world experiences, and other physical materials.	Objectives: Students... • develop multiple approaches to working with numbers • name the whole number before and after a given whole number
Standard #2: Understand our numeration system by relating counting, grouping, and place value concepts.	Objectives: Students... • count, recognize, write, order, and compare numbers (up to 100) • skip count by 2s, 3s, 5s, 10, • count forward and backwards from a given number • understand and recognize fractions ($\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$) • model and describe place value for two digit numbers using objects • use number words • understand and use ordinal numbers • using manipulatives construct situations for the understanding of odd and even numbers
Standard #3: Interpret multiple uses of numbers encountered in real world situations.	Objectives: Students... • recognize the use of different types of numbers in the real world
Standard #4: Understand the basic concepts of fractions, mixed numbers, and decimals.	Objectives: Students... • identify and understand $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$
Standard #5: Apply estimation when working with quantities, computation, and measurement.	Objectives: Students... • estimate small quantities of objects using a point of reference

Number Sense, Computation, and Operations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop operation sense for whole numbers, fractions, and decimals.	Objectives: Students... • demonstrate an understanding and knowledge of addition and subtraction facts using multiple strategies (i.e. counting on, inverse operations, missing addends etc.....) • model and discuss the concrete representation of "less than, greater than, and equal to" • describe the relationship between addition and subtraction • demonstrate a variety of methods for finding from known facts
Standard #2: Relate the mathematical language and symbolism of operations to problem situations>	Objectives: Students... • solve addition and subtraction problems using manipulatives, coins, patterns relationships, and numbers
Standard #3: Identify a variety of problem structures that can be represented by a single operation.	Objectives: Students... • explore, discuss, and apply addition and subtraction in a wide variety of contexts
Standard #4: Model, explain, and develop proficiency with basic facts and algorithms.	Objectives: Students... • recognize situations in which addition and subtraction apply and use them to construct and solve problems with whole numbers • model and formulate addition and subtraction problems up to two digit by two digit problems without regrouping
Standard #5: Use calculators in appropriate computation situations.	Objectives: Students... • use a calculator to count to 100 and to skip count by 25, 35, 55, and 10
Standard #6: Model and understand equivalency of fractions and their relationship to decimals.	Objectives: Students... • understand and demonstrate the equivalency of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ in terms of money

Number Sense and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop and apply number theory concepts.

Objectives: Students...

- use a variety of concrete materials to demonstrate number relationships

Number Sense and Discrete Math:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Explore discrete mathematics concepts.

Objectives: Students...

- record the counting of various occurrences (i.e. how many outfits can you make from 3 different colored shirts and 2 different colored pairs of pants)

Strand #2: Patterns, Relations, and Functions

Patterns, weave mathematical topics together. Through the study of patterns, children learn to see relationships and make connections, generalizations, and predictions about the world around them. (NCTM Standards)

Patterns and Relations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Identify, describe, extend, and create a wide variety of numerical and geometric patterns.

Objectives: Students...

- identify, extend, and create patterns in many forms (number line, 100 charts, calculator, geometrically)
- use and make predictions about repeating patterns

Standard #2: Represent and describe mathematical relationships.

Objectives: Students...

- link and understand written symbols to objects, numbers and words

Standard #3: Explore the use of variables and open sentences to express relationships.

Objectives: Students...

- recognize observable regular events and shapes and work with generalizable patterns to express relationships

Patterns and Relations (continued)

Standard #4: Use patterns and relationships to represent, analyze, and solve mathematical problems.	Objectives: Students... • sort, classify and make comparisons and search for patterns while working with data and numbers
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Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Formulate and write number sentences for real problems.	Objectives: Students... • use coins, manipulatives, numbers, and patterns in number sense form
Standard #2: Explain strategies used in finding missing components in patterns, sequences, and numbers.	Objectives: Students... • identify a missing piece of a pattern, in a sequence, or in a mathematical sentence (i.e., missing addend)
Standard #3: Use concrete materials to understand maintaining balances in number sentences.	Objectives: Students... • use manipulatives to model balancing in number sentences
Standard #4: Explore and explain the use of variables in a number sentence.	Objectives: Students... • identify the commutative and associative property of addition concretely and abstractly

Strand #3: Geometry and Measurement

Geometry and measurement help us represent and describe, in an orderly fashion, the world in which we live. (NCTM Standards & MA Mathematics Curriculum Framework)

Geometry and Spatial Sense: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, name, model, draw, and classify two-dimensional and three-dimensional shapes and figures.	Objectives: Students... • recognize, draw, name geometric shapes in the environment (square, triangle, rectangle, circle) • make and construct 2D/3D shapes and models • identify, describe and discuss likeness/ differences of objects and collections of objects that can be manipulated, seen or visualized • identify patterns in geometrical objects such as symmetry

Geometry and Spatial Sense (continued)

Standard #2: Investigate and predict the results of combining, subdividing, and changing shapes.	Objectives: Students... • identify and recognize fractional parts of shapes
Standard #3: Develop spatial sense.	Objectives: Students... • recognize shape in different orientations • understand and use positional words and relationships
Standard #4: Use geometric ideas to develop numerical and measurement ideas	Objectives: Students... • understand examples of quantity, space, and shapes using real objects

Measurement:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Demonstrate the attributes of perimeter, area, volume, weight, capacity, time, temperature, angle, and money.	Objectives: Students... • estimate and use non-standard and standard units to compare and order objects by size,: length, width, weight, and height • identify coins (penny, nickel, dime, and quarter) and know their values • name the days of the week, months of the year, and seasons • use clocks to tell time by hour and half hour
Standard #2: Use the process of measuring and the concepts related to units of measure.	Objectives: Students... • choose a unit of measure and compare it to a real object and report the number of units
Standard #3: Make and use estimates of measure.	Objectives: Students... • select a real object and estimate its weight, length, or height

Strand #4: Probability and Statistics

Statistics and probability are important links to other content areas, such as social studies and science. They also reinforce communication skills as children discuss and write about their activities and their conclusions. Within mathematics, these topics regularly involve the uses of number, measurement, estimation, and problem solving." (NCTM Standards)

Probability and Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Collect, organize, and describe data.	Objectives: Students... • collect, display and interpret data
Standard #2: Construct, read, and interpret displays of data.	Objectives: Students... • construct graphs and analyze and discuss results
Standard #3: Formulate and solve problems that involve collecting and analyzing data.	Objectives: Students... • use pictures and symbols to characterize and group objects, and to solve problems
Standard #4: Explore and describe concepts of chance.	Objectives: Students... • make predictions about an event happening • record and discuss the results of activities related to chance

BPS Learning Standards: Second Grade Mathematics

Strand #1: Number Sense

If children have number sense, they understand the relationship of numbers to each other, are able to tell when an answer or a unit of measurement is reasonable, and can use numbers effectively in many situations. (NCTM Standards, Grade 2 Addendum)

Number Sense, Numeration, and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Construct number meaning by using manipulatives, real world experiences, and other physical materials.	Objectives: Students... • develop a variety of approaches to working with numbers • work with manipulatives in a variety of models • name the whole number before and after a given whole number
Standard #2: Understand our numeration system by relating counting, grouping, and place value concepts.	Objectives: Students... • count, recognize, write, order, and compare numbers (up to 1000) • skip count by 2s, 3s, 5s, and 10s • record expanded notation to 1000 • identify place value to hundreds(1-100) • use number words • understand and use ordinal numbers
Standard #3: Interpret multiple uses of numbers encountered in real world situations.	Objectives: Students... • identify numbers in their environment
Standard #4: Understand the basic concepts of fractions, mixed numbers, and decimals.	Objectives: Students... • construct, recognize and compare fractions such as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{10}$
Standard #5: Apply estimation when working with quantities, computation, and measurement.	Objectives: Students... • use a variety of strategies and situations for estimating quantities up to 100 • use estimation to determine the appropriateness of an answer in computation • round to the nearest tens

Number Sense, Computation and Operations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop operation sense for whole numbers, fractions, and decimals.

Objectives: Students...

- use concrete materials to solve computational problems
- know when to use addition and subtraction
- describe the relationship between addition and subtraction
- explore and understand beginning multiplication

Standard #2: Relate the mathematical language and symbolism of operations to problem situations.

Objectives: Students...

- use, discuss, create, and solve problems about numbers
- write number sentences to match problems and write problems to match number sentences
- write and solve word problems using addition and subtraction: apply the problems to quantities, computation, measurement, and geometry

Standard #3: Identify a variety of problem structures that can be represented by a single operation.

Objectives: Students...

- explore addition, subtraction, and multiplication in a variety of contexts (use concrete materials and multiple experiences to understand (i.e. skip counting, patterns on a hundreds chart etc...))

Standard #4: Model, explain, and develop proficiency with basic facts and algorithms.

Objectives: Students...

- understand the meaning of and master concepts of computational procedures using whole numbers
- understand and demonstrate knowledge of addition and subtraction fact through 20 and develop strategies for finding facts one can not recall readily
- demonstrate understanding of three digit addition and subtraction with and without regrouping
- find the sums of three or more single digit addends
- count by 5s and 10s with money and time
- explore multiplication and recognize the relationship to repeated addition (1, 10, 5, 2, , and 9)
- demonstrate the ability to set up addition and subtraction equations both horizontally and vertically

Number Sense, Computation and Operations (continued)

Standard #5: Use calculators in appropriate computation situations.	Objectives: Students... • use a basic calculator to solve problems in addition and subtraction
Standard #6: Model and understand equivalency of fractions and their relationship to decimals.	Objectives: Students... • use money (decimal notation)

Number Sense and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop and apply number theory concepts.	Objectives: Students... • use concrete materials to understand the meaning of odd and even numbers
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Number Sense and Discrete Math:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Explore discrete mathematics concepts.	Objectives: Students... • sort and classify sets by many attributes • use a variety of strategies to determine combinations and arrangements of objects, coins, outfits etc.... • extend , use, and understand combinations • extend number and pattern sequences
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Strand #2: Patterns, Relations, and Functions

Recognizing patterns and predicting what comes next are crucial problem solving skills that children must develop early if they are to succeed. (NCTM Standards)

Patterns and Relations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Identify, describe, extend, and create a wide variety of numerical and geometric patterns.	Objectives: Students... • identify, name, create, and extend patterns (numerical, geometrical, in daily life: number line, hundreds chart, calculator etc..)
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Patterns and Relations (continued)

Standard #2: Represent and describe mathematical relationships.	Objectives: Students... • explore and demonstrate an understanding of the commutative and associative properties in addition • understand the relationship among operation • match written symbols to objects, numbers, quantity, and words • understand the language of numbers (i.e. more than, less than)
Standard #3: Explore the use of variables and open sentences to express relationships.	Objectives: Students... • represent relationships with models, graphs, and rules • demonstrate an understanding of the missing addend
Standard #4: Use patterns and relationships to represent, analyze, and solve mathematical problems.	Objectives: Students... • search for patterns in mathematical sentence • search for patterns in their math work and everyday lives

Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Formulate and write number sentences for real problems.	Objectives: Students... • use coins, manipulatives, numbers, and patterns in number sense form
Standard #2: Explain strategies used in finding missing components in patterns, sequences, and numbers.	Objectives: Students... • identify a missing piece of a pattern, in a sequence, or in a mathematical sentence (i.e., missing addend)
Standard #3: Use concrete materials to understand maintaining balances in number sentences.	Objectives: Students... • use manipulatives to model balancing in number sentences
Standard #4: Explore and explain the use of variables in a number sentence.	Objectives: Students... • use concrete objects as symbols or variables that can be manipulated

Strand #3: Geometry and Measurement

To develop spatial sense, children must have many experiences that focus on geometric relationships: the direction, orientation, and perspectives of objects in space. (NCTM Standards)

Geometry and Spatial Sense: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, name, model, draw, and classify two-dimensional and three-dimensional shapes and figures.	Objectives: Students... • make and construct 2D/3D shapes and models • recognize, draw, and name geometric shapes in the environment • identify properties and attributes of shapes
Standard #2: Investigate and predict the results of combining, subdividing, and changing shapes.	Objectives: Students... • use and describe transformations (slides, flips, turns) and combine them in simple ways • copy, extend, and create patterns • understand angle as a measure of turn and recognize quarter turns and half turns
Standard #3: Develop spatial sense.	Objectives: Students... • recognize shapes and figures from different perspectives • predict new shapes that can be made from combinations of other shapes • identify symmetry and the line of symmetry in shapes, objects, and figures
Standard #4: Use geometric ideas to develop numerical and measurement ideas (i.e., use an area model on the geoboards to develop an understanding and visual image of fractions).	Objectives: Students... • locate and describe positions on a number line and coordinate planes using positional words (up, down, left, right) • use rectangular arrays to explore multiplication

Measurement: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Demonstrate the attributes of perimeter, area, volume, weight, capacity, time, temperature, angle, and money.	Objectives: Students... • identify coins, their values, and their equivalencies • compute area and perimeter of basic figures using concrete units • tell time to the hour, quarter/half hour, minutes • name the days, months, and seasons • use and understand a calendar • read a thermometer to the nearest degree

Measurement (continued)

Standard #2: Use the process of measuring and the concepts related to units of measure.	Objectives: Students... • select and use appropriate units and tools of measure (ruler, cup, scale) • use customary standard units in meaningful contexts to measure, order, and compare length, weight, and capacity(inches, feet, pounds, cups)
Standard #3: Make and use estimates of measure.	Objectives: Students... • use a variety of methods of estimation in terms of working with numbers, computation, and measurement

Strand #4: Probability and Statistics

Children need to recognize that many kinds of data come in many forms, and that collecting, organizing, displaying, and thinking about them can be done in many ways". (NCTM Standards)

Probability and Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Collect, organize, and describe data.	Objectives: Students... • use a variety of methods and materials to manipulate and organize data (tallies, lists, bar graphs)
Standard #2: Construct, read, and interpret displays of data.	Objectives: Students... • tally, record, and discuss results of data gathering • interpret and discuss Venn diagrams using 2 or 3 sets
Standard #3: Formulate and solve problems that involve collecting and analyzing data.	Objectives: Students... • compare and contrast quantities of objects on real and picture graphs
Standard #4: Explore and describe concepts of chance.	Objectives: Students... • carry out simple probability activities using concrete materials (dice, coins, spinners) • use the language of probability (likely, unlikely possible)

BPS Learning Standards: Third Grade Mathematics

Strand #1: Number Sense

Number sense is the ability to understand and use numbers and operations on numbers in computation, measurement, and estimation situations" (NCTM Standards)

Number Sense, Numeration, and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Construct number meaning by using manipulatives, real world experiences, and other physical materials.	Objectives: Students... • develop multiple approaches to working with numbers
Standard #2: Understand our numeration system by relating counting, grouping, and place value concepts.	Objectives: Students... • count forward and backward from any given number • name the whole number 10 and 100 before or after a given number • read, write & identify place value of numbers 0-9999 • compare and order quantities: use number sentences with $>$, $<$, & $=$ • record 2 & 3 digits numbers in expanded form • recognize the patterns of 1s, 10s, & 100s in each period of a number
Standard #3: Interpret multiple uses of numbers encountered in real world situations.	Objectives: Students... • create story problems and numerical operations related to numbers
Standard #4: Understand the basic concepts of fractions, mixed numbers, and decimals.	Objectives: Students... • compare fractions such as $\frac{1}{2}$, $\frac{1}{4}$, & $\frac{1}{10}$ with $>$, $<$, & $=$ • recognize the patterns & relationship between decimal numbers and money (coins) • write penny, dime, & quarter, in both fraction and decimal forms • understand the relationship between fractions and mixed numbers in measuring tools • explore ratio in simple fractions
Standard #5: Apply estimation when working with quantities, computation, and measurement.	Objectives: Students... • round numbers to the nearest 10, 100, & 1,000 • determine when it is appropriate to use estimation to solve a problem • use estimation to determine the reasonableness of an arithmetic solution

Number Sense, Computation and Operations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop operation sense for whole numbers, fractions, and decimals.

Objectives: Students...

- solve problems by selecting the appropriate operation (+, -, x, & simple ÷)
- use & relate concrete materials to solve computation problems
- recognize when to apply regrouping in multi-digits addition and subtraction
- understand relationships between operations, e.g. multiplication is repeated addition & division is repeated subtraction

Standard #2: Model and recognize real-life situations in which +, -, x & ÷ occur

Objectives: Students...

- write and solve story problems about money, length, volume, area, capacity involving all four operations

Standard #3: Understand and develop proficiency with basic facts & algorithms by exploring +, -, x & ÷ in a variety of ways and context

Objectives: Students...

- understand the computation concepts & procedures for whole & decimal numbers & fractions
- demonstrate fluency in basic +, -, x, and ÷ facts

Standard #4: Use calculators in appropriate computation situations

Objectives: Students...

- check computation involving large numbers or data
- verify relationship between x & area

Number Sense and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop and apply number theory concepts

Objectives: Students...

- explore how numbers evolve in various cultures
- apply knowledge of commutative & associative properties in addition & multiplication
- use concrete materials to demonstrate understanding of distribution property multiplication over addition and subtraction

Number Sense and Discrete Math: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Explore discrete math concepts	Objectives: Students... • explore commutative, & associative properties using concrete materials • use Venn diagrams to classify objects with unique and similar attributes

Strand #2: Patterns, Relations, and Functions

Recognizing patterns and predicting what comes next are crucial problem solving skills that children must develop early if they are to succeed. (NCTM Standards)

Patterns and Relations: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Identify, describe, extend and create a variety of numerical patterns	Objectives: Students... • link number of digits to place value • use a hundred chart to skip count & recognize the pattern for multiplication • able to identify missing digits in a number sequence • create and recognize patterns in arrays of unit cubes
Standard #2: Represent and describe mathematical relationships	Objectives: Students... • understand relationships between operations, e.g., multiplication is repeated addition & division is repeated subtraction • know fact families • recognize that the numeral in the one's digit determines whether a number is odd or even • recognize the patterns of outcome in computational operations involving odd or even numbers • explore commutative, associative, and distributive properties using concrete materials
Standard #3: Use patterns and relationships to represent, analyze, and solve mathematical problems	Objectives: Students... • use concrete materials, charts, & graphs to explore and model mathematical relationships

Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Explain strategies used in finding missing components in patterns, sequences, and number sentences, e.g. missing addends	Objectives: Students... • recognize that any missing component in a number sentence is determined by the relationship between the known components

Strand #3: Geometry and Measurement

To develop spatial sense, children must have many experiences that focus on geometric relationships: the direction, orientation, and perspectives of objects in space. (NCTM Standards)

Geometry and Spatial Sense: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, name, draw & classify lines, 2D figures & 3D shapes	Objectives: Students... • recognize, identify, & appreciate geometry in our world • describe buildings & their geometric shapes • explore lines and points • identify and classify properties and attributes of 2D figures and 3D shapes
Standard #2: Investigate & predict the results of combining, subdividing, & changing shapes	Objectives: Students... • recognize and understand transformations (slide, flips, & turns) • recognize that rotations, slide, flips do not change the size of a figure or shape • copy, extend, and make patterns on the plane • recognize the relationship between 2D figures & 3D shapes, e.g., a cube has 6 square faces
Standard #3: Use mirrors, tangrams, drawings & paper folding to develop spatial sense	Objectives: Students... • predict how changing the measure of the sides of a plane figure affect its dimensions, area and perimeter • identify symmetry in simple 2D figures • explore symmetry in familiar 3D shapes • recognize congruence and similarity between simple figures & shapes
Standard #4: Use geometric ideas to develop numerical & measurement ideas, e.g., use the dimensions of a rectangle on graph paper to illustrate factors and products in multiplication	Objectives: Students... • locate and describe positions on a number line or coordinate plane • explore the relationship between addition & perimeter and multiplication & area

Measurement:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Recognize uniform measuring units are necessary for the purpose of communicating, comparing, & calculating dimensions, temperature, weight & capacity

Objectives: Students...

- use customary standard units (cups, pints, quarts, gallons, inches, foot, yard, etc.) to measure, order, compare, and classify real objects.
- select and use the appropriate measuring instrument according to the task
- select and use the appropriate units to report measuring data
- record & interpret linear measurement reading to 1/2 inch accuracy
- use estimation to determine the reasonableness of measuring data
- record and interpret temperature readings to the nearest 5 degrees
- use estimation and common sense to determine a reasonable temperature to perform common activities, e.g. swimming, skating, skiing, weather, etc.

Standard #2: Recognize time is a measurement of duration between events

Objectives: Students...

- fluency in naming common time measurement, e.g., month, year, week, day & hour
- tell time by the hour, 1/2 hour, 1/4 hour, and minutes using a digital or analog clock
- use estimation to determine the duration of an event

Standard #3: Recognize money's relationship to the decimal number system

Objectives: Students...

- fluency in recognizing the values and equivalencies in common bills (\$1, \$10) & coins (\$.01, \$.05, \$.10, \$.25, & \$.50)
- match money (including coins) with price tags

Strand #4: Probability and Statistics

Children need to recognize that many kinds of data come in many forms, and that collecting, organizing, displaying, and thinking about them can be done in many ways". (NCTM Standards)

Probability and Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Explore and describe games of chance	Objectives: Students... • explore probability with concrete materials (two colors counter, dice, coins, etc.) through games such as shake and spill, pig, & spinners
Standard #2: Collect, organize, & describe data	Objectives: Students... • use tally marks, charts (T-charts, frequency charts), tables, & graphs) (pictographs, bar graphs) to collect, organize, & describe data
Standard #3: Construct display, read, & interpret a given set of data	Objectives: Students... • understand sorting or organizing data into visual displays (charts & graphs) is essential to data analysis • read and use data to predict patterns of outcome
Standard #4: Apply knowledge on how to use data to predict outcomes to solve real life problems	Objectives: Students... • understand the relationship between data and outcome • connect data to mathematical representations & operations

BPS Learning Standards: Fourth Grade Mathematics

Strand #1: Number Sense

Number sense is the ability to understand and use numbers and operations on numbers in computation, measurement, and estimation situations" (NTCM Standards)

Number Sense, Numeration, and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Construct number meaning by using manipulatives, real world experiences, and other physical materials.	Objectives: Students... • develop multiple approaches to working with numbers
Standard #2: Understand our numeration system by relating counting, grouping, and place value concepts.	Objectives: Students... • skip count backward and forward, by 1s through 12s, and by common fractions ($1/2$, $1/4$, $1/5$, $1/10$) • count forward and backward from a given number • identify and apply place value through hundred thousands: use numbers and words • compare and order quantities: use number sentences with $<$, $>$, $=$ • record numbers in expanded notation • use, discuss, create, and solve problems about numbers • use ordinal numbers • write number sentences and stories to match expressions, and expressions to match number sentences and stories
Standard #3: Interpret multiple uses of numbers encountered in real world situations.	Objectives: Students... • use numbers in a variety of real world situations
Standard #4: Understand the basic concepts of fractions, mixed numbers, and decimals.	Objectives: Students... • construct, model, recognize, compare, and order simple fractions (halves, thirds, fourths, fifths, eighths, and tenths), mixed numbers with these fractions, and decimals • recognize and understand decimals through their connections with money and measurement • explore and understand the concept of ratio and proportion in solving simple problems • understand simple percents (10%, 5%, 50%, 100%)

Number Sense, Numeration, and Estimation (continued)

Standard #5: Apply estimation when working with quantities, computation, and measurement.	Objectives: Students... • determine when an estimate is appropriate • use and describe multiple strategies in applying estimates • determine the reasonableness of estimates by checking solutions using a variety of means (paper and pencil, calculators, mental math, etc.) • know the appropriateness of the size of a numbers in addition, subtraction, multiplication, and division • round numbers to the nearest 10, 100, 1000, 10000 • round decimals and fractions to the nearest whole number
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Number Sense, Computation, and Operations: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Develop operation sense for whole numbers, fractions, and decimals.	Objectives: Students... • use concrete materials to solve computational problems • know when to use addition, subtraction, multiplication, and division • describe the relationship between operations
Standard #2: Relate the mathematical language and symbolism of operations to problem situations.	Objectives: Students... • write and solve word problems using all 4 operations: apply problems to quantities, computation, measurement (i.e.. money, time, etc.) and geometry (i.e.. area, perimeter, etc.)
Standard #3: Identify a variety of problem structures that can be represented by a single operation.	Objectives: Students... • explore and apply addition, subtraction, multiplication, and division in a variety of contexts (i.e.. use concrete materials and multiple experiences to develop an understanding of multiplication as repeated addition, geometric arrays, skip counting, patterns on a 100 chart, etc.)

Number Sense, Computation, and Operations (continued)

Standard #4: model, explain, and develop proficiency with basic facts and algorithms.	Objectives: Students... • understand the meaning of and master concepts of computational procedures using whole numbers, fractions, and decimals • know the basic arithmetic facts with fluency • understand and demonstrate knowledge of multiplication facts through 12X12, and develop a variety of strategies for finding facts one can't recall readily • use distributive property of multiplication over addition and subtraction • find an average of whole numbers • explore and comprehend division as area and repeated subtraction • explore and comprehend the division algorithm (including the concept of remainders) and its relationship to multiplication • multiply up to 2 digits by 2 digits • divide by a single digit with remainders
Standard #5: Use calculators in appropriate computation situations.	Objectives: Students... • use calculators in problem solving situations involving integration of computational skills
Standard #6: Model and understand equivalency of fractions and their relationship to decimals.	Objectives: Students... • illustrate and find the sum and difference of fractions with like denominators ($\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{10}$) • add and subtract tenths and hundredths in fraction and decimal forms

Number Sense and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop and apply number theory concepts.	Objectives: Students... • understand and describe the structure of the Roman Numeral system: 1 to 10 • explore how numbers evolved in other cultures (i.e. Chinese, Roman, Greek) • use concrete materials to find and understand the meaning of prime & composite numbers and odd & even numbers • identify and recognize the relationship between multiples and factors • recognize how odd, even, prime, and composite numbers influence computational outcomes
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Number Sense and Discrete Math:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Explore discrete mathematics concepts.

Objectives: Students...

- use simple strategies to determine combinations and arrangements of objects, coins, outfits, etc.

Strand #2: Patterns, Relations, and Functions

Patterns, relations, and functions form the base of mathematics. Recognizing patterns and describing their relationships mathematically by using geometry, number, sequences, and functions, helps us interact with and make sense of our world. (MA Mathematics Curriculum Frameworks: Achieving Mathematical Power)

Patterns and Relations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Identify, describe, extend, and create a wide variety of numerical and geometric patterns.

Objectives: Students...

- recognize, name, create, extend, and analyze numerical and geometric patterns in many forms (i.e., develop an understanding of multiplication through patterns on a 100 chart or on a calculator using the + and = keys)
- use simple function machines
- use a T-chart to record numerical data, explore and analyze number patterns, and formulate rules and generalizations

Standard #2: Represent and describe mathematical relationships.

Objectives: Students...

- explore and demonstrate an understanding of the commutative and associative properties
- understand the relationship among operations
- link written symbols to objects, numbers, quantities, and words

Standard #3: Explore the use of variables and open sentences to express relationships.

Objectives: Students...

- represent relationships with models, tables, graphs, and rules

Standard #4: Use patterns and relationships to represent, analyze, and solve mathematical problems.

Objectives: Students...

- use numerical and geometric patterns as a strategy for solving problems

Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Formulate and write number sentences for real problems.	Objectives: Students... • formulate, wrote, and explain number sentences for authentic problems
Standard #2: Explain strategies used in finding missing components in patterns, sequences, and numbers.	Objectives: Students... • identify a missing piece of a pattern, in a sequence, or in a mathematical sentence (i.e., missing addend)
Standard #3: Use concrete materials to understand maintaining balances in number sentences.	Objectives: Students... • use manipulatives to model balancing in number sentences (i.e., $3 \times 4 = 2 \times \{\}$)
Standard #4: Explore and explain the use of variables in a number sentence.	Objectives: Students... • use concrete objects as symbols or variables that can be manipulated

Strand #3: Geometry and Measurement

To develop spatial sense, children must have many experiences that focus on geometric relationships: the direction, orientation, and perspectives of objects in space. (NCTM Standards)

Geometry and Spatial Sense: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, name, model, draw, and classify two-dimensional and three-dimensional shapes and figures.	Objectives: Students... • recognize, identify, and appreciate geometry in our world • identify properties and attributes of 2-D and 3-D shapes • identify and construct lines (parallel and perpendicular), points, segments, rays, and angles
Standard #2: Investigate and predict the results of combining, subdividing, and changing shapes.	Objectives: Students... • use and describe transformations (slides, flips, turns) and combinations of transformations • explore and describe shape relationships (i.e., find the shapes possible when 4 equilateral triangles are connected so that each shares a common side) • copy, extend, and create patterns in a plane

Geometry and Spatial Sense (continued)

Standard #3: Develop spatial sense.	Objectives: Students... • explore, recognize, and describe shapes and figures from different perspective • predict new shapes that can be made from combinations of other shapes • identify and draw lines of symmetry of 2-D and 3-D shapes and figures
Standard #4: Use geometric ideas to develop numerical and measurement ideas (i.e., use an area model on the geoboards to develop an understanding and visual image of fractions).	Objectives: Students... • locate and describe positions on a number line and coordinate plane • understand and calculate through concrete explorations the area, perimeter, and volume of simple figures • explore and understand congruency and similarity between shapes and figures • use rectangular arrays to explore factors, primes, composites, multiples, etc.

Measurement:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Demonstrate the attributes of perimeter, area, volume, weight, capacity, time, temperature, angle, and money.	Objectives: Students... • find the area, perimeter, volume of shapes, and explore relationship between these concepts • compare analog to digital time; tell time to nearest minute; calculate time intervals • use a calendar to solve problems • identify coins and bills, and understand the value of a set of coins and bills • make change from \$10, \$100, etc. • use a systematic process to find combinations of coins for a give amount
Standard #2: Use the process of measuring and the concepts related to units of measure.	Objectives: Students... • select and use appropriate units and tools of measure • use customary standard units in meaningful contexts: measure, order, compare, classify length, weight, capacity of objects and containers (in., ft., yd., lb., oz., cup, pt., qt., gal.) • use metric units for length, mass, and liquid measurements • read, record, and interpret numbers on measuring instruments with pre-specified accuracy (i.e., nearest $\frac{1}{2}$ inch) • measure and record hot and cold temperatures on a thermometer (+ and - numbers)

Measurement (continued)

Standard #3: Make and use estimates of measure.	Objectives: Students... • use a variety of methods of estimation in terms of working with numbers, computation, and measurement
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Strand #4: Probability and Statistics

Statistics and probability are important links to other content areas, such as social studies and science. They can also reinforce communication skills as children discuss and write about their activities and their conclusions. Within mathematics, these topics regularly involve the uses of number, measurement, estimation, and problem solving. (NCTM Standards)

Probability and Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Collect, organize, and describe data.	Objectives: Students... • use tally sheets and other strategies such as T-charts, stem and leaf charts to collect, sort, record, and describe data
Standard #2: Construct, read, and interpret displays of data.	Objectives: Students... • read and make tables and graphs to display data; interpret results and make predictions (i.e., frequency charts, single and double bar graphs, line graphs, circle graphs, Venn Diagrams, etc.)
Standard #3: Formulate and solve problems that involve collecting and analyzing data.	Objectives: Students... • use and analyze survey data; discuss results and make predictions
Standard #4: Explore and describe concepts of chance.	Objectives: Students... • carry out simple probability activities using concrete materials (coins, dice); extend and use the understanding of possible combinations • explore the language of probability such as likely, unlikely, probable, possible, etc.

BPS Learning Standards: Fifth Grade Mathematics

Strand #1: Number Sense

Children with number sense use numbers flexibly and choose the most appropriate representation of a number for a given circumstance. When solving problems, they are able to select from various strategies and tools. They predict with some accuracy the results of an operation and describe the relationships between the various forms of numbers. This 'friendliness' with numbers goes far beyond mere memorization of algorithms and number facts and implies an ability to recognize when operations are required and when they have been correctly performed.

(NCTM Standards)

Number Sense and Number Relationships:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand, represent, and use equivalent forms of numbers (integers, fractions, decimals, percents, exponents, and scientific notation) in the real world and in problem solving situations.	Objectives: Students... • identify, describe, and apply the fraction and decimal equivalence to each other and for the following percents: 1%, 5%, 10%, 25%, 50%, 100% • identify, describe, and apply decimal notation to money • recognize, write, and use tenths and hundredths in the context of money • write ratios and equal ratios emphasizing equivalence of fractions and multiplying by one
Standard #2: Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • identify and use place value through the millions: use numbers and words • compare and order numbers to one billion: use number sentences with $<$, $>$, $=$ • write numbers in standard and expanded notation • read, write, and locate on the number line integers and fractions • recognize and use percents: 1%, 5%, 10%, 25%, 50%, 100% • describe, order, and compare fractions and mixed numbers with like and unlike denominators • describe, order, and compare decimals
Standard #3: Understand and apply ratios, proportions, and percents.	Objectives: Students... • use rates to state the relationship (ratio) between two quantities • demonstrate an understanding of ratios, proportions, and percents using concrete materials, tables, etc.

Number Sense and Number Relationships (continued)

Standard #4: Investigate and describe the relationship among fractions, decimals, and percents.	Objectives: Students... • discover and describe the relationship among fractions, decimals, and percents
Standard #5: Represent numerical relationships in one- and two-dimensional graphs.	Objectives: Students... • record and describe the composition and decomposition of sets of objects and numbers in graph form to understand numerical relationships.

Number Sense, Computation, and Estimation: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Compute with whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • add, subtract, multiply, and divide whole numbers with multiple digits • add, subtract, multiply, and divide decimals • add and subtract fractions and mixed numbers with like and unlike denominators • demonstrate an understanding of multiplication and division of fractions using concrete materials • find the average of a set of numbers (whole numbers, fractions, and decimals)
Standard #2: Develop, analyze, and explain procedures for computation and techniques for estimation.	Objectives: Students... • use and describe different strategies to estimate quantities • use estimation to solve whole number operations; compute and compare results • round to nearest 10, 100, 1000, million • round fractions and decimals to nearest whole number
Standard #3: Develop, analyze, and explain procedures for solving proportions.	Objectives: Students... • use and describe different strategies to solve proportions and explain the difference in the procedures used
Standard #4: Select and use an appropriate method for computing from among mental arithmetic, paper and pencil, calculator, and computer methods.	Objectives: Students... • develop, use, and describe effective methods of computation (i.e. mentally, orally; on paper, calculators, and computers)

Number Sense, Computation, and Estimation (continued)

Standard #5: Use computation, estimation, and proportions to solve problems.	Objectives: Students... • use computation and estimation procedures to solve problems
Standard #6: Estimate to check the reasonableness of results.	Objectives: Students... • determine the reasonableness of an estimate by checking solutions using a variety of strategies

Number Systems and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and explain the need for numbers other than whole numbers.	Objectives: Students... • create and solve story problems and situations where numbers other than whole numbers are necessary
Standard #2: Know and use order relations for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • know and use order of operations including use of parentheses
Standard #3: Use operations involving fractions, decimals, integers, and rational numbers.	Objectives: Students... • use operations involving fractions and decimals to solve problems
Standard #4: Demonstrate how basic operations are related to one another.	Objectives: Students... • explain the relationship of operations
Standard #5: Create and apply number theory concepts, including prime numbers, factors, and multiples.	Objectives: Students... • understand and demonstrate knowledge of multiplication facts with factors: 1-12, 100, 1000 • identify and demonstrate an understanding of common multiples, factors, prime and composite numbers • use prime factorization to determine the least common multiple (LCM) and greatest common factor (GCF) of whole numbers • understand and apply the divisibility principle using 2, 3, 5, 9, 10

Number Sense and Discrete Math:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Explore discrete mathematics concepts.

Objectives: Students...

- use and explain Venn Diagrams to model the union and intersection of sets as related to real life situations and problems
- use patterns and relations to model arrangements, combinations, and permutations of objects
- determine the outcome of a simple flow chart
- continue number and pattern sequences

Strand #2: Patterns, Relations, and Functions

Patterns, relations, and functions form the base of mathematics. Recognizing patterns and describing their relationships mathematically by using geometry, number, sequences, and functions, helps us interact with and make sense of our world. (MA Mathematics Curriculum Frameworks: Achieving Mathematical Power)

Patterns and Functions:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Describe, extend, analyze, and create a wide variety of patterns .

Objectives: Students...

- describe, extend, analyze, and create geometric and numerical patterns

Standard #2: Describe and represent relationships with models, tables, graphs, and rules; use sentences and algebraic expressions.

Objectives: Students...

- describe and solve problems about numbers
- use data on tables to show relationships of numbers; describe patterns

Standard #3: Analyze functional relationships to explain how a change in one quantity results in a change in another.

Objectives: Students...

- use and find a function rule from tables and charts

Standard #4: Use patterns and functions to represent and solve problems.

Objectives: Students...

- use and describe numerical and geometric patterns to solve problems
- sort, classify, make comparisons, and identify patterns while working with numbers, data, shapes, and objects to solve real world problems

Algebra:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and apply the concepts of variable, expressions, and equation.	Objectives: Students... • solve problems using numbers, operations, and relations which include an unknown • investigate patterns involving numerical operations that can be generalized to an expression with a variable or place holder
Standard #2: Represent situations and number patterns with tables, graphs, verbal rules, and equations, and explore the interrelationships of these representations.	Objectives: Students... • use the language of relationships (i.e. half the size, less than, multiple of, factor of, symmetrical to, etc.) • use a T-chart to record, describe, and analyze numerical patterns; make predictions for unknown entities based on generalizations, rules, and/or formulas • use a coordinate grid to graph number patterns (i.e. multiples of 3)
Standard #3: Analyze tables and graphs to identify properties and relationships.	Objectives: Students... • use tables and graphs to identify properties and relationships
Standard #4: demonstrate an ability to solve linear equations using concrete, informal, and formal methods.	Objectives: Students... • use concrete, informal and formal methods to solve linear equations
Standard #5: describe the strategies used to explore inequalities and nonlinear equations.	Objectives: Students... • solve inequalities and nonlinear equations and describe the strategies used for each
Standard #6: apply algebraic methods to solve a variety of real-world and theoretical problems.	Objectives: Students... • use patterns and relationships to develop algebraic ideas in all areas of mathematics
Standard #7: construct expressions or equations that model problems.	Objectives: Students... • write sentences and number stories to match mathematical expressions and write mathematical expressions to match number sentences and word problems
Standard #8: explore and describe a variety of ways to solve equations: include hands-on activities, trial and error, and numerical analysis.	Objectives: Students... • use and describe a variety of ways to solve equations

Algebra (continued)

Standard #9: know and apply algebraic procedures for solving equations and inequalities.	Objectives: Students... • solve equations and inequalities and apply these procedures to real world problems.
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Strand #3: Geometry and Measurement

The study of geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretation can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Identify, describe, compare, and classify geometric figures.	Objectives: Students... • identify, classify, describe, compare and draw polygons including scalene, isosceles, equilateral, and right triangles and quadrilaterals such as rectangles, squares, parallelograms, diamonds, hexagons, etc. • identify, draw, and describe figures in terms of symmetry, similarity, and congruency
Standard #2: Explore and describe the properties of points, lines, and planes.	Objectives: Students... • identify, describe, and construct points, lines (parallel and perpendicular), segments, rays, planes, angles • identify types of angles and name them using letters • use a coordinate grid to locate ordered pairs and related points on a line or in a shape (i.e. vertices of a rectangle)
Standard #3: Visualize and represent (ie build, draw) geometric figures.	Objectives: Students... • construct circles: identify, describe, and draw the center, radius, diameter, and circumference • use a compass, ruler, and protractor to construct simple plane figures including angles and circles • predict, model, and describe the results of combining, subdividing, and changing shapes
Standard #4: Explore and describe transformations of geometric figures.	Objectives: Students... • tessellate pattern pieces in a plane • use and describe transformation (i.e. slides, flips, turns)

Geometry (continued)

Standard #5: Represent and solve problems using geometric models.	Objectives: Students... • use geometric models to solve problems
Standard #6: Understand and apply geometric properties and relationships.	Objectives: Students... • use manipulatives to model and explain the relationship among geometric shapes
Standard #7: Develop and explain the concept of Pi.	Objectives: Students... • measure the diameter and circumference of five circular objects of different sizes and show how the ratios of these two measurements are related to Pi
Standard #8: Develop and explain the concept of the Pythagorean Theorem.	Objectives: Students... • measure the areas of three rectangles to explain the concept of the Pythagorean Theorem

Measurement:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Estimate, make, and use measurements to describe and compare phenomena.	Objectives: Students... • describe the reasonableness of an estimate or an accurate measurement • use proportional reasoning to solve and create measurement problems
Standard #2: Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.	Objectives: Students... • select and use the appropriate system of measurement in real-life problems • select and use the appropriate units and tools to measure with precision and accuracy
Standard #3: Understand the process, structure, and use of systems of measurement.	Objectives: Students... • actively explore the real world to use appropriate tools in measuring objects
Standard #4: Describe the meaning of and use perimeter, area, volume, angle measure, capacity, density, weight, and mass as forms of measurement.	Objectives: Students... • use customary and metric units to measure and describe lengths (i.e. m., cm., km., mm.) • solve and create a variety of problems using the area, perimeter, volume, and surface area of rectangles, triangles, cubes, and boxes

Measurement (continued)

Standard #5: Develop, describe, and use the concepts of rates and other derived and indirect measurements.	Objectives: Students... • create and solve a variety of problems dealing with rates and other derived and indirect measurements
Standard #6: Develop and apply formulas and procedures for determining measures to solve problems.	Objectives: Students... • calculate time intervals and use conversions (from one unit to another) to solve problems

Strand #4: Probability and Statistics

A knowledge of statistics is necessary if students are to become intelligent consumers who can make critical and informed decisions. (NCTM Standards)

Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Collect, organize, and describe data systematically.	Objectives: Students... • devise and use a systematic, clear process for collecting and organizing data (i.e. T-chart, tally sheet, Venn Diagram, etc.); refine as needed
Standard #2: Construct, read, and interpret tables, charts, and graphs.	Objectives: Students... • make and interpret tables and graphs • construct circle graphs, and interpret representation in terms of fractions and percents • construct a variety of graphs and explain the reason for choice of presentation (i.e. line vs. bar graph or graph vs. table, etc.)
Standard #3: Make inferences and convincing arguments that are based on data analysis.	Objectives: Students... • design and implement a survey; make inferences based of an analysis of the results • make predictions and form generalizations, hypotheses, rules, and conjectures based on numerical data and geometric patterns which are organized on tables, charts, diagrams, etc.
Standard #4: Evaluate arguments that are based on data analysis.	Objectives: Students... • use data analysis techniques to evaluate arguments and sound decision making
Standard #5: Develop and explain why statistical methods are powerful aids for decision making.	Objectives: Students... • find and describe the mean, median, mode, and range of given data

Probability: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Model situations by devising and carrying out experiments or simulations to determine probabilities.	Objectives: Students... • calculate and combine probabilities to solve real-life problems (coin toss, dice games); tally, record, and describe the results
Standard #2: Construct a sample space to determine probabilities.	Objectives: Students... • derive probabilities by building a table or tree diagram, create an area model, make a list, or use simple counting procedures
Standard #3: Describe the power of using a probability model by comparing experimental results with mathematical expectations.	Objectives: Students... • conduct experiments to determine experimental probability and construct a table to establish the theoretical probability and compare the two results
Standard #4: Make predictions that are based on experimental or theoretical probabilities, and determine their reasonableness.	Objectives: Students... • make and evaluate predictions based on probability experiments and in terms of reasonableness
Standard #5: Develop an appreciation for the pervasive use of probability in the real world.	Objectives: Students... • select five areas of interest to them (i.e., weather, sports, etc.) and show how probability is used in each area

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**Science
Kindergarten-Fifth Grade**

**Version 96.1
June 28, 1996**

Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework

Science
Kindergarten-Fifth Grade

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Science in the Boston Public Schools: Introduction

Purpose

Put simply, the purpose of science education in the Boston Public School is for students to understand both how *to do* and *to use* science so they will value and participate in the intellectual, democratic, and vocational possibilities of science in American society.

The Nature of Science

Science may be simply described as human attempts to give good accounts of the patterns we see in nature. The characteristics of a “good account” and the particular “patterns we see” are the essence of scientific debate and consequence. The output of science, in its purist form, is ideas. At their scientific best, ideas become theories and laws. Overall, it may be said that the key criterion of science is that it is a clear, rational and preferably law-like account of a pattern in nature based on publicly accessible evidence and inferences, and accompanied by a model that offers a naturalistic explanation, whether conceptual, mathematical and/or mechanical.

The Use of Science

In its purist form science is an intellectual tradition, an inheritance of a set of ideas about nature: how it works, what is not yet known, and how to learn more. Because science has been successful from time to time in the foregoing pursuits, it is possible to use this information for practical efforts which make useful products of nature. This practical effort is called technology.

Our Standards

We have identified twelve standards in Science Understandings and Skills. These standards build from those identified in the National Science Education Standards and the Massachusetts Science Curriculum Frameworks. We expect all students to achieve the following standards, by the end of high school:

Science Understandings:

Standard #1: Students understand the role of observation and experimentation in the scientific process and the development of scientific theories.

Standard #2: Students understand the “big ideas” of science: the unifying concepts of the life sciences, physical sciences, and earth and space sciences.

Standard #3: Students have a deep understanding of the key concepts, principles, phenomena, and basic factual material included in at least one of the following subjects: biology, chemistry, or physics.

Standard #4: Students understand how humans use technology and the design process to respond to the natural world and to solve everyday problems.

Standard #5: Students understand humankind's interactions with nature over time, the technologies we have developed, the benefits and consequences of our actions, and the impact of science.

Standard #6: Students connect the study of science and technology to a variety of career opportunities.

Science Skills:

- Standard #1:** Students ask appropriate scientific questions, recognize experimental approaches to answering such questions, and develop their own answers to many questions through personal observation and experimentation.
- Standard #2:** Students gather scientific information through observation and experimentation in the laboratory and in the field; through questioning and interviewing; and through library work and other information-gathering activities.
- Standard #3:** Students organize the results obtained by observation, experimentation, questioning, interviewing, and library work, differentiating between evidence, inference, and opinion; they check and revise their explanations against scientific knowledge, experiences, and the observations of others.
- Standard #4:** Students communicate the results obtained by observation, experimentation, questioning, interviewing, and library work, through models, illustrations, narratives, and oral presentations.
- Standard #5:** Students research, analyze, and evaluate social, environmental, and personal challenges, problems and concerns, through observation, experimentation, research, and the application of the unifying concepts of science.
- Standard #6:** Students utilize appropriate technologies (including calculator-based laboratories, micro-computer based laboratories, CD-ROM, laser discs, and telecommunications), to expand the own capacity to obtain, utilize, and present information effectively, and to apply science principles to the solution of design/ engineering problems.

Criteria for the Development of the Science Standards and Curriculum Frameworks:

The following criteria guided the development of the K-12 science standards and curriculum framework for the Boston Public Schools. We chose to:

- Honor the intellectual coherence and common currency of each of the scientific domains (life sciences, physical sciences, space and earth sciences), while integrating content and instruction, wherever practical, through topics that will build students' understanding of concepts from more than one domain.
- Align our efforts with the National Science Education Standards, the Massachusetts Science Curriculum Framework, and the curriculum and materials development efforts sponsored by the National Science Foundation.
- Ensure that all students are engaged in hands-on science instruction in every grade.
- Ensure that all graduates develop scientific literacy in each of the major science domains and an in-depth understanding of at least one of the following domains: Biology, Chemistry, Physics.
- Ensure that good materials are available to teachers and students, given the standards we've developed for the particular grade levels.

- Seek a proper balance between depth of understanding and breadth of content covered. If we want students to *do* and to *use* science, they must have a deep understanding of the most essential science concepts, and be able to apply this understanding in meaningful ways. We have identified the minimum core science to be taught (70% of science instruction), while leaving teachers time for elective units (30% of science instruction).

Organization and Requirements:

Students in grades K-9 will study topics that include and often integrate concepts from the Life Sciences, Physical Sciences, Earth and Space Sciences, and Technology each year. Students in grades K-2 will receive a minimum of 90 minutes of hands-on science instruction per week. Students in grades 3-5 will receive a minimum of 135 minutes of hands-on science instruction per week. Students in grades 6-9 will receive a minimum of 225 minutes of hands-on science instruction per week.

High school level courses beyond the ninth grade will remain specialized, at least until more integrated materials are readily available. These courses will include Biology, Chemistry, and Physics at every high school in the city. Each student is required to successfully complete three years of high school science, including Integrated Science in the ninth grade, and either Biology, Chemistry, or Physics.

Format Guide:

The Curriculum Frameworks for each grade are arranged according to three categories: Student Requirements, Content Objectives (Topics), and Skill Objectives. Below are brief descriptions of each category.

1. **Student Requirements:** These are tasks students must complete as a condition of course completion.
2. **Content Objectives:** Each topic is described in five sections:
 - a. **Key Questions:** These are open ended, non-judgmental, inquiry-promoting questions that invite exploration of concrete, yet wide-ranging issues and problems. They do not address generic issues, such as “patterns” or “change,” nor do they ask for answers to specific queries, such as, “What is the speed of light?” To answer these questions well students must:
 - engage in disciplined inquiry, emphasizing the use of evidence, inference, and model building.
 - deeply understand key concepts and principles.
 - reference key people, events, phenomena, discoveries, documents, etc.
 - make connections between the content, their experiences, and the world outside of school.
 - communicate their findings clearly and precisely.
 - b. **Key Concepts, Principles, Lessons, and Phenomena:** These are the concepts, and lessons students must understand. Students will be able to clearly explain them, using real-world examples, apply them to the solution of real-world problems, and reference them when answering Key Questions.
 - c. **Entry Points and Applications:** These are people, events, objects, ideas, and themes that are especially provocative, illustrative, or accessible. They serve as entry points for, or examples/applications of, the content of each topic. Students will use these to enter, illuminate, or apply their knowledge of the topic, and to answer Key Questions.
3. **Skill Objectives:**
 - a. **Skills and Processes:** These are skills students must develop to conduct scientific inquiry.
 - b. **Technologies and Instruments:** These are items students will learn to use.
4. **The Science Domains: Grade Level Content Connections**

The topics of each grade are aligned with the *Massachusetts Curriculum Frameworks Science and Technology Curriculum Content Chapter: Owning the Questions*. Each Framework Strand has been woven into the BPS Curriculum Framework. Inquiry appears in the Key and Sub-Questions of each topic. The Technology and Human Affairs Strands are woven throughout the Key Questions; the Key Concepts, Principles, Lessons, and Phenomena; the Entry Points and Applications; and the Technologies and Instruments sections of the BPS Curriculum Framework.

In the section entitled "The Science Domains: Grade Level Content Connections", the Key Concepts, Principles, Lessons, and Phenomena from the BPS Curriculum Frameworks have been arranged in the appropriate Domains of Science (Life, Physical, and Earth and Space Sciences), as defined by the Massachusetts Curriculum Frameworks, to illustrate the connections between the Massachusetts and the BPS curriculum frameworks.

Kindergarten Science:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Keep a notebook of at least four original illustrations of objects and organisms per science topic studied during the school year, including illustrations of their partial and complete answers to the Key Questions and Subquestions for each topic.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Participate in story circles and share reports about famous scientists or inventors, about science topics, or about literature including science.
- * Make a presentation to other students, teachers, and/or parents. Talk about an activity they have completed, a conclusion they have reached, and one observation or piece of evidence that helped them reach the conclusion (e.g., the student provides evidence that not all objects are attracted to a magnet).
- Pass teacher tests of terms and concepts presented in the year’s topics.
- Complete their homework.
- * Complete one “Boston Science Activity Reports” (oral or written) per marking term.
- Report on an interview with a practicing or applied scientist, or an older BPS student who has completed a science fair project. A group interview of a classroom visitor is sufficient.
- Complete one "Why This Topic?" summary or essay per topic.

Important Note:

All students are expected to complete one of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select one of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: Our Five Senses

Key Questions: What do peoples’ senses do?

Subquestions:

- What do animals’ senses do?
- How are different animals’ (including humans’) senses the same?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- The senses are sight, sound, touch, taste, and smell.
- The senses yield information about internal and external environment.
- There is variation among humans in their ability to sense.
- In animals, sense may be more or less sensitive than in humans.

Entry Points and Applications:

- A baseball game • Pitch • Visual acuity • Grades of sandpaper
- Devices that heighten sensory awareness (hearing aids, glasses, binoculars)
- Perfumes/aroma therapy • Blindfold walks

Topic: Force and Motion I: Characteristics of Balls

Note: Close attention must be paid to the sequencing of Force and Motion I & II, between Kindergarten and the Second Grade.

Key Questions: How do balls move?

Subquestions:

- How do we describe balls?
- How are different balls the same?
- For what can we use balls?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Balls bounce, rolls, spin, glide, float and move in a variety of other ways.
- Characteristics of balls--materials, size, weight.
- Societal uses of balls.

Entry Points and Applications:

- Balls--ping pong, baseball, golf, kick, beach, tennis etc.
- Bubbles
- Footballs
- Marbles
- Raceways exhibits at The Children's Museum

Topic: Water

Key Question: Where does water come from? Where does water go?

Subquestions:

- For what do people use water?
- What mixes with water?
- What is good water?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Water is a liquid and can change shape to fit the container it is in.
- The water cycle and sources of water.
- Societal uses of water.
- Water mixed with other things may be good or bad depending on its use

Entry Points and Applications:

- Charles River
- MWRA
- Deer Island Treatment Plant
- Rain
- Kitchen sink
- Drinking fountain

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Planning and conducting a simple investigation, including:
 - a. Asking a question about objects, organisms, and events in the natural world,
 - b. Employing simple equipment and tools to gather and extend the senses,
 - c. Using evidence, inference, and models to construct a reasonable explanation, and
 - d. Communicating their investigations and explanations.

(This set of skills primarily contributes to fulfilling the ability "to do science" portion of the Purpose.)

2. Knowing how science helps to solve some social and personal issues, but not others.

(This skill, in addition to those in Item 1, contributes to fulfilling the ability “to use science” portion of the Purpose.)

* Adapted from the National Research Council’s *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- Hand lens
- Ruler
- Eye droppers

First Grade Science:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Keep a notebook of at least four original illustrations of objects and organisms per science topic studied during the school year, including illustrations of their partial and complete answers to the Key Questions and Subquestions for each topic.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Participate in story circles and share reports about famous scientists or inventors, about science topics, or about literature including science.
- * Make a presentation to other students, teachers, and/or parents. Talk about an activity they have completed, a conclusion they have reached, and one observation or piece of evidence that helped them reach the conclusion (e.g. the student provides evidence that not all objects are attracted to a magnet).
- Pass teacher tests of terms and concepts presented in the year’s topics.
- Complete their homework.
- * Complete one “Boston Science Activity Reports” (oral or written) per marking term.
- Report on an interview with a practicing or applied scientist or an older BPS student who has completed a science fair project. A group interview of a classroom visitor is sufficient.
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip such as Whale Watch, Trailside Museum, Arnold Arboretum, or Community Project).
- Complete one Why This Topic? summary or essay per topic.

Important Note:

All students are expected to complete one of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select one of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: Living Things

Key Questions: What characterizes a living thing?

Subquestions:

- What are the similarities and differences among living things?
- What are the needs of living things?
- How do living things meet their needs?
- What is a useful living thing?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- The characteristics of life.
- Living things grow, change, and die over time.

Key Concepts, Principles, Lessons, and Phenomena (continued):

Students will understand...

- Living things have common needs, such as food, water, sunlight, and shelter.
- Different living things satisfy needs differently.
- Living things require other living things for their needs.

Entry Points and Applications:

- Birds
- Farmer
- Classroom pet
- Pet shop owner
- Goldfish
- Veterinarian
- Squirrels
- Zoo keeper

Topic: The Sky and Its Common Natural Objects

Key Question: What is in the sky? What is weather?

Subquestions:

- What changes in the sky?
- What causes weather?
- How does weather affect society?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- The sun warms the land, air, and water.
- Wind, water, heat from the sun, the Earth's surface, air, and some industrial products combine to create weather.
- Cases of positive and negative affects of weather on society.
- The sun can be seen only in the daytime. The moon can be seen sometimes at night and sometimes during the day. Stars (other than the sun) can be only be seen at night.
- The sun, the moon, and the stars all appear to move slowly across the sky.
- There are more stars in the sky than anyone can easily count but they are not scattered evenly, and they are not all the same color and brightness.

Entry Points and Applications:

- Lightning
- Nor'easter
- Francis Beaufort
- Weather balloon
- Weather Station
- Sun
- Moon
- Stars
- Venus
- Constellations
- Meteorologist/TV Weathermen
- Clouds
- Coast Guard
- Observatories: Museum of Science, Boston University, University of Massachusetts, Harvard College
- Snow Days
- Weather reports/reporters

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Planning and conducting a simple investigation, including:
 - a. Asking a question about objects, organisms, and events in the natural world,
 - b. Employing simple equipment and tools to gather and extend the senses,
 - c. Using evidence, inference, and models to construct a reasonable explanation, and
 - d. Communicating their investigations and explanations.

(This set of skills primarily contributes to fulfilling the ability "to do science" portion of the Purpose.)

2. Knowing how science helps to solve some social and personal issues, but not others.

(This skill, in addition to those in Item 1, contributes to fulfilling the ability “to use science” portion of the Purpose.)

* Adapted from the National Research Council’s *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- Hand lens • Rain gauge • Rulers • Thermometer • Weather vane
- Anemometer
- One "game" type software program that introduces and/or reviews one age-appropriate science topic/concept.

Students will be able to access science information from CD-ROM.

The Science Domains: First Grade Content Connections

Life Sciences

- Characteristics of living things
- Needs of living things
- Effect of living things on the environment
- Life cycles
- Adaptations
- Relationship of living things to each other

Physical Sciences

- Solids, liquids and gases
- Temperature
- Sparks and lightning
- Energy: light, heat, and electricity
- Light and shadows

Earth and Space Sciences

- Weather
- Water cycle
- Weather and society
- Cloud types
- Precipitation
- Wind
- Forecast
- Objects in the sky: sun, moon, stars, planets

Second Grade Science:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Keep a notebook of at least four original illustrations of objects and organisms per science topic studied during the school year, including illustrations of their partial and complete answers to the Key Questions and Subquestions for each topic.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Complete book reports about famous scientists or inventors, about science topics, or about literature including science.
- * Make a presentation (to other students, teachers, and/or parents), explaining a concept in one of the year’s topics and demonstrating their ability to differentiate fact from opinion. They will also complete a drawing or make a model demonstrating the concept.
- Pass teacher tests of terms and concepts presented in the year’s topics.
- Complete their homework.
- * Complete two “Boston Science Activity Reports” (oral or written) per science topic studied.
- Report on an interview with a practicing or applied scientist or an older BPS student who has completed a science fair project. A group interview of a classroom visitor is sufficient.
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip such as Whale Watch, Trailside Museum, Arnold Arboretum, or Community Project).
- Complete one Why This Topic? summary or essay per topic.

Important Note:

All students are expected to complete one of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select one of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: The Life Cycle

Key Questions: What is a life cycle?

Subquestions:

- How are different animals' life cycles the same?
- What affects life cycles?
- What is a human life cycle?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Life cycle is a progression of life from less complex (young) to more complex (adult).
- Different animals develop through different life cycle patterns.
- Environmental affects on life cycle.
- Cases of animal life cycles.

Entry Points and Applications:

- Butterflies
- Eggs
- Frogs
- Grasshoppers
- Meal worms

Topic: Local Environments

Key Question: What is a habitat?

Subquestions:

- How do organisms use their habitat?
- How do habitats differ?
- How do changes in habitats affect the organisms that live in them?
- How do changes in habitats affect human society?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Habitats provide for an organisms needs.
- Organisms adapt to and survive in a particular habitat.
- The interaction between habitats and their inhabitants.
- Cases of habitat changes and society's response.

Entry Points and Applications:

- Alewife Brook
- Arnold Arboretum
- Boston Harbor
- Jamaica Pond
- Peregrine falcons nesting on the Customs Tower
- Tropical Rain Forest

Topic: Force and Motion II: The Motion of Balls

Key Questions: How do balls move?

Subquestions:

- How de we describe ball motion?
- How do balls start moving?
- How do balls stop moving?
- How do balls move on ramps?
- How do different balls move on the same ramp?
- How do the same balls move on different ramps?
- How can we make a ball move faster and slower?
- How is the motion of balls similar to other objects?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Ball motion is affected by its size, weight, material, and structure (hollow vs. solid).
- Balls and other objects need a force to begin moving and stop moving.
- The motion of balls and other objects is affected by gravity and friction.
- Momentum

Entry Points and Applications:

- Bowling allies
- Roller coasters
- Hot Wheels
- Raceways exhibits at The Children's Museum

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Planning and conducting a simple investigation, including:
 - a. Asking a question about objects, organisms, and events in the natural world,
 - b. Employing simple equipment and tools to gather and extend the senses,
 - c. Using evidence, inference, and models to construct a reasonable explanation, and
 - d. Communicating their investigations and explanations.

(This set of skills primarily contributes to fulfilling the ability “to do science” portion of the Purpose.)

2. Knowing how science helps to solve some social and personal issues, but not others.

(This skill, in addition to those in Item 1, contributes to fulfilling the ability “to use science” portion of the Purpose.)

* Adapted from the National Research Council’s *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- Hand lens • Compass
- Game-type software programs that simulate a science investigation.

Students will be able to retrieve information and conduct a conversation on a science topic via telecommunications (i.e. two-way cable program, internet).

The Science Domains: Second Grade Content Connections

Life Sciences

- Characteristics of living things
- Life cycles
- Habitats
- Organisms interact with the environment
- Interrelationships between organisms
- Effect of habitats on humans
- Growth and development
- Plant and animal adaptations

Physical Sciences

- Force
- Motion
- Gravity
- Friction
- Energy
- Magnets

Earth and Space Sciences

- Human impact on the environment

Third Grade Science:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Develop a portfolio of at least four original illustrations of objects and organisms per science topic studied during the school year.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Complete book reports about famous scientists or inventors, about science topics, or about literature including science.
- * Make a presentation (to a large or small group of students and teachers) including evidence, an inference and a model used to explain a concept in one of the year's topics.
- * Keep a notebook of their partial and complete answers to the Key Questions and Subquestions of each topic.
- Pass teacher tests of terms and concepts presented in the year's topics.
- Complete their homework.
- * Complete three “Boston Science Activity Reports” per science topic studied.
- Report on an interview with a practicing or applied scientist or an older BPS student who has completed a science fair project. A group interview of a classroom visitor is sufficient.
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip such as Whale Watch, Trailside Museum, Arnold Arboretum, or Community Project).
- * Complete a science exposition, including individual or team projects or whole-class theme-based projects with individually-differentiated tasks (see “Protocols” for Science Fair/Science Exposition).
- Report on a TV science or technology program.
- Complete one Why This Topic? summary or essay per topic.

Important Note:

All students are expected to complete one of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select one of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: Flowering Plant Life Cycle

Key Questions: How does a flowering plant get from one generation to the next?

Subquestions:

- What are the characteristics of plants?
- How can the growth of plants be changed?
- How does one flowering plant differ from another (across species, within species)?
- How does American society use flowering plants?

NOTE: This unit does not address plant nutrition. It is very difficult to demonstrate (i.e. provide evidence of) the atmospheric needs of plants to third grade children. Without this demonstration, it is impossible to counter a major botanical misconception that plants primarily feed on water and soil.

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Flowering plant life cycle: flower, fruit, seed, seedling, vegetative plant, flower, etc.
- Structure and function of primary plant: roots, stems, leaves, flowers, and how these differ for different plants.
- Seed structure.
- Many trees are flowering plants
- Flowering plants have many, many cultural uses such as food, objects of pleasure, sources of drugs and other chemicals, building materials, paper, and sources of clothing fibers and dyes.

Entry Points and Applications:

- Roses, tulips, daffodils and lilacs
- Seeds as food (corn, wheat, rice, oats, barley, sesame, walnuts, acorns)
- George Washington Carver
- Commercial greenhouses and flower shops
- Radishes (very fast to sprout and mature, usually good eating)
- Vegetable or fruit farmer
- Produce section of the grocery store
- Seed and flower catalogs (Burpee, Jackson & Perkins)
- New England Flower Show

Topic: Sound

Key Question: How are sounds made?

Subquestions:

- How is volume changed?
- How is pitch changed?
- How are sounds used in American society?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Sounds are vibrations whose waves the human ear can detect.
- Loudness is a measure of the energy of the vibration.
- Pitch is a function of the frequency or rapidity of the vibration.
- Sounds provide pleasure (music, gently running water), warning (sirens, whistles, shouts), and communication (school bells, church bells, elevator arrival).

Entry Points and Applications:

- Popular and classical musical groups
- Scary sounds, funny sounds, sad sounds, happy sounds
- Guitar, piano, drum, trumpet, flute

Topic: Liquids

Key Question: What characterizes a liquid?

Subquestions:

- How do liquids differ?
- How are liquids used in American society?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Liquids flow and take the shape of their containers.
- In a stiff container, liquids are hard to squeeze (resistance to compression).

Key Concepts, Principles, Lessons, and Phenomena (continued):

Students will understand...

- Different liquids have different degrees of stickiness (viscosity).
- Liquids can be a mix of several materials.
- The characteristics of a liquid determine whether and how well an object will float in it.
- Liquids are used for food, pleasure, health, and industry.

Entry Points and Applications:

- Water, alcohol, honey, corn syrup, shampoo, salt water
- Floating and sinking objects
- Coke and Pepsi
- A bath
- Squeaky doors and lubricants
- Construction equipment that utilize hydraulics (i.e. backhoe and bucket loader)

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Planning and conducting a simple investigation, including:
 - a. Asking a question about objects, organisms, and events in the natural world,
 - b. Employing simple equipment and tools to gather and extend the senses,
 - c. Using evidence, inference, and models to construct a reasonable explanation, and
 - d. Communicating their investigations and explanations.(This set of skills primarily contributes to fulfilling the ability “to do science” portion of the Purpose.)

2. Knowing how science helps to solve some social and personal issues, but not others.

(This skill, in addition to those in Item 1, contributes to fulfilling the ability “to use science” portion of the Purpose.)

* Adapted from the National Research Council’s *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- Rulers
- Magnifiers
- Thermometers
- Simple balance and spring scales
- Tuning forks
- Stopwatch
- Hydraulic pump

Students will be able to receive information on a science topic accessed by the teacher via cable or internet.

The Science Domains: Third Grade Content Connections

Life Sciences

- Plant characteristics
- Factors that affect plant growth
- Uses of plants
- Life cycle of plants
- Plant structure
- Seeds
- Trees

Physical Sciences

- Forms of energy: sound, electricity and magnetism, light, motion
- Characteristics of sound: quality, pitch, amplitude
- Wave
- Vibration
- Amplification
- Sources of sound
- Transformation of energy
- Solids, liquids, and gases
- Properties of liquids

Earth and Space Sciences

- Environmental affects on plant growth

Fourth Grade Science:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Develop a portfolio of at least four original illustrations of objects and organisms per science topic studied during the school year.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Complete book reports (oral or written) about famous scientists or inventors.
- * Make a presentation (to a large or small group of students and teachers) including evidence, an inference and a model used to explain a concept in one of the year’s topics.
- * Keep a notebook of their partial and complete answers to the Key Questions and Subquestions of each topic.
- Pass teacher tests of terms and concepts presented in the year’s topics.
- Complete their homework.
- Pass the Citywide Curriculum Assessment in fourth grade science. (Not a requirement for 1996-1997.)
- * Complete four “Boston Science Activity Reports” per science topic studied.
- Report on an interview with a practicing or applied scientist or an older BPS student who has completed a science fair project, or present their science exposition to young students and answer questions from them. (This make take the place of the presentation above.)
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip such as Whale Watch, Trailside Museum, Arnold Arboretum, or Community Project).
- * Complete a science exposition, including individual or team projects or whole-class theme-based projects with individually-differentiated tasks (see “Protocols” for Science Fair/Science Exposition).
- Report on a TV science or technology program.
- Complete one Why This Topic? summary or essay per topic.

Important Note:

All students are expected to complete one of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select one of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students’ work. During the summer of ’97, we hope to bring teachers together to examine and discuss samples of students’ work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: Bones

Key Questions: Why are there bones?

Subquestions:

- Where are there bones?
- How do bone structures relate to bone function?
- How are different animals’ bones similar?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- The structure and function of the major bone groups in the human body.
- The structure and function of different types of teeth.
- Animals have different bone structures which lead to different ways to grow, survive, and reproduce.

Entry Points and Applications:

- Owl pellets
- Loose teeth
- Wisdom teeth
- Knee injuries
- Broken bones
- Bone marrow transplants

Topic: Rocks in the Environment

Key Question: What do rocks tell us about the Earth's past?

Subquestions:

- From where do rocks come?
- Where do rocks go?
- Of what are rocks made?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- The geologic cycle: rocks have histories.
- Rocks are made of minerals.
- Sources of different kinds of rocks.
- Rocks come in many shapes and sizes, from boulders to grains of sand and even smaller.
- Fossils provide evidence of the Earth's history.

Entry Points and Applications:

- Rocks
- Stone buildings
- Gravel pits and quarries
- Beaches
- Boston "puddingstone"
- Boston Sand and Gravel Co
- The Big Dig
- Science Museum's Big Dig exhibit
- Rock collection in the Museum of Comparative Zoology

Topic: Magnets

Key Question: What does a magnet do?

Subquestions:

- From where do magnets come?
- How are magnets used by society?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Magnetic attraction.
- Magnetic field.
- Magnetic force.
- Nature of magnetism.
- How magnets are made.
- How magnets can lose their magnetism.
- The uses of magnets.

Entry Points and Applications:

- Magnets and iron filings
- Compass
- Earth
- Lodestone

Topic: Electricity

Key Question: How does electricity move?

Subquestions:

- What are the societal uses of electricity?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Properties of electricity.
- Electric circuits.
- Conductors and nonconductors.
- Societal uses of electricity.
- Volt, amp, ohm, and watt.

Entry Points and Applications:

- Flashlight
- Batteries and bell circuits
- Light bulb
- Lightning
- Ben Franklin
- Battery tester
- Fuse
- Circuit Breaker

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Planning and conducting a simple investigation, including:
 - a. Asking a question about objects, organisms, and events in the natural world,
 - b. Employing simple equipment and tools to gather and extend the senses,
 - c. Using evidence, inference, and models to construct a reasonable explanation, and
 - d. Communicating their investigations and explanations.(This set of skills primarily contributes to fulfilling the ability “to do science” portion of the Purpose.)
2. Knowing how science helps to solve some social and personal issues, but not others.
(This skill, in addition to those in Item 1, contributes to fulfilling the ability “to use science” portion of the Purpose.)

* Adapted from the National Research Council’s *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- Hand lens
 - Ruler
 - Circuit tester
 - Volt meter
 - Amp meter
- Students will be able to share observations concerning a scientific phenomenon via telecommunications (i.e. Kidsnet, Bosnet, Environet).

The Science Domains: Fourth Grade Content Connections

Life Sciences

- Structure and function of bones and teeth
- Characteristics of animals
- Invertebrates
- Vertebrates
- Animal adaptations

Physical Sciences

- Energy
- Types of energy
- Energy transformations
- Electric circuits
- Conductors and nonconductors
- Insulators

Earth and Space Sciences

- Rocks and minerals
- Rock cycle
- Characteristics of rocks
- Fossils
- Weathering
- Erosion
- Water cycle
- Precipitation
- Wind

Fifth Grade Science:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Develop a portfolio of at least four original illustrations of objects and organisms per science topic studied during the school year.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Complete book reports (oral or written) about famous scientists or inventors.
- * Make a presentation (to a large or small group of students and teachers) including evidence, an inference and a model used to explain a concept in one of the year’s topics.
- * Keep a notebook of their partial and complete answers to the Key Questions and Subquestions of each topic.
- Pass teacher tests of terms and concepts presented in the year’s topics.
- Complete their homework.
- Pass the Citywide Curriculum Assessment in fifth grade science. (Not a requirement for 1996-1997.)
- * Complete four “Boston Science Activity Reports” per science topic studied.
- Report on an interview with a practicing or applied scientist or an older BPS student who has completed a science fair project, or present their science exposition to young students and answer questions from them. (This may take the place of the presentation above.)
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip such as Whale Watch, Trailside Museum, Arnold Arboretum, or Community Project).
- * Complete a science exposition, including individual or team projects or whole-class theme-based projects with individually-differentiated tasks (see “Protocols” for Science Fair/Science Exposition).
- Report on a TV science or technology program.
- Complete one Why This Topic? summary or essay per topic.

Important Note:

All students are expected to complete one of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select one of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: The Microscopic World

Key Questions: What is seen with a microscope?

Subquestions:

- What do living things look like through a microscope?
- What characterizes a microscopic living thing?
- How are microorganisms alike and different from macroorganisms?
- How do microorganisms affect our world?
- What do nonliving things look like through a microscope?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Microscopes make it possible to see that living things are made mostly of cells. Some organisms are made of a collection of similar cells. Some organisms' cells vary greatly in appearance and it may be inferred that these have very different roles in the organism.*
- The ways living and nonliving things are similar and different when seen through a microscope.

* From the American Association for the Advancement of Science's *Benchmarks for Science Literacy* (1993).

Entry Points and Applications:

- Tuberculosis
- Development of penicillin
- Robert Hooke
- Effects of smallpox on Native American populations
- Anton van Leeuwenhoek
- Louis Pasteur
- Germ theory of disease

Topic: Astronomy

Key Questions: How do we describe the Earth, Moon, stars, and planets?

Subquestions:

- What observations did ancient peoples make about the Earth, Moon, stars, and planets?
- Why does the Moon look the way it does?
- Why does the night sky look the way it does?
- Why is there day and night?
- Why are there seasons?
- How are earth-based and satellite-based observations different?
- How are constellations used?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- There are different objects in the sky.
- The arrangement of celestial bodies is called the solar system.
- In our solar system there are nine planets and one large star called the Sun. There are other stars called stars.
- The Earth is a planet.
- Relative movements of the celestial bodies cause seasons, night and day, phases of the moon, and eclipses.
- Light from celestial bodies is either produced or reflected.
- Celestial navigation.

Entry Points and Applications:

- Hubble telescope
- Polynesian migration
- Voyager (space probe)
- Nicolaus Copernicus
- Galileo Galilei
- Edwin Powell Hubble
- Johannes Kepler
- Isaac Newton
- Ptolemy
- Flat Earth Theory

Topic: Chemistry

Key Question: How do we describe matter?

Subquestions:

- What are the physical properties of a substance?
- What are the chemical properties of a substance?
- When are chemicals harmful?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Substances possess characteristic physical and chemical properties.
- Chemical properties can be identified by chemicals known as indicators.
- Useful chemicals can be hazardous.

Entry Points and Applications:

- Clorox
- Drano
- Hazardous spill
- Road salt
- pH paper

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Designing and conducting a scientific investigation. Students:
 - a. Identify questions that can be answered through scientific investigations,
 - b. Use appropriate tools and techniques to gather, analyze, and interpret data,
 - c. Develop descriptions, explanations, predictions, and models using evidence,
 - d. Recognize and analyze alternative explanations and predictions,
 - e. Communicate scientific procedures and explanations, and
 - f. Use mathematics in all aspects of scientific inquiry.(This set of skills primarily contributes to fulfilling the ability “to do science” portion of the Purpose.)
2. Evaluating social or personal issues in terms of how science can and cannot contribute to their clarification and resolution. Students:
 - a. Identify aspects of social and personal issues which can be addressed through scientific study
 - b. Prudently apply scientific knowledge to these social or personal issues.(This skill, in addition to those in Item 1, contributes to fulfilling the ability “to use science” portion of the Purpose.)

* Adapted from the National Research Council’s *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- a simple compound microscope
- a simple telescope
- binoculars
- scientific data received through telecommunications, to compare and contrast with their own observations, and to strengthen or revise their conclusions regarding some scientific investigation(s)

The Science Domains: Fifth Grade Content Connections

Life Sciences

- Microorganisms: characteristics, affects on environment, life cycles, living and non-living
- Cells: one-celled living things, many celled living things, germ theory and disease

Physical Sciences

- Light, lenses, and magnification
- Chemistry: physical properties; chemical properties including color change, temperature change, production of a gas, solubility; chemical changes including acid and bases; forms of energy including heat and light; particulate nature of matter

Earth and Space Sciences

- Objects in the sky: sun, moon, planets, stars, comets, meteorites, satellites
- Phases of the moon
- Moon observation
- Night and day
- Eclipses
- Seasons
- Constellations
- Solar system
- Light from celestial bodies

Protocols for Student Requirements in Science:

The purpose of the protocols is to describe minimum requirements for successful fulfillment of student responsibilities in science. In addition, the protocols supply a list of resources that might be used by the teacher, student, parents and/or guardian. In support of these student requirements, the Boston Public Schools recognizes that it must provide rubrics and exemplars that clarify the types and quality of work expected of students, grades K-12, and that promote the kinds of science teaching and learning required throughout the curriculum.

1. The Boston Science Laboratory/Activity Report

The Boston Science Laboratory/Activity Report is required of all students at all grade levels. For grades K-5, the report is called a Science Activity Report. For grades 5-12, the report is called a Science Laboratory Report. The difference in names reflects differences in mode of communication, required content, and comprehensiveness and sophistication of presentation and analysis, in relation to the expected cognitive and experiential ability of the student.

The purpose of the report is to promote clear and logical communication about scientific ideas between the person conducting the investigation and his/her audience. At the kindergarten level, the report can be as simple as a child reporting to the teacher what she/he sees, hears, or feels, and what she/he thinks about the observations. This oral report might be accompanied by a drawing or short written statement. For example, a child feels the fur on a bunny or gerbil (the observations) and states that the fur is soft and keeps the animal warm (the inference or explanation). The child draws a picture of the animal, with emphasis on the fur, or writes a sentence reflecting the observation and explanation. As children become older, more informed, and more sophisticated, the format and content of the Science report parallels this growth.

Science Activity Report Format

Grades K-2: The basic format is 1) an observation based on direct sense perception of a natural phenomenon or object and 2) a statement (oral or written) of interpretation (inference, explanation, metaphor). Natural phenomena or objects includes all things of nature (animals, clouds, plants, rocks and soil, human body, etc.) as well as manipulations of nature as seen in experiments. Statements of interpretation are any ideas that go beyond what is directly perceived by the senses. For example, an animal's fur is for keeping it warm, an animal drinks water because it is thirsty, or the sun feels hot because it is made of fire.

Grades 3-5: The format remains the same as K-2 but with the following two additions: 1) The report must be written and 2) the data of the observation must be included in the form of a drawing or illustration, or chart or graph. It will help the child to note that their report is meant to answer, at least in part, one or more of the key questions.

Reports will begin with a) a title and listing of the phenomenon or object of study, b) the specific observations that the child made, c) the data that support the observation, and d) the interpretation of what was observed. See sample Science Report.

Science Laboratory Report Format

Grades 6-8: The core of the report remains the same as the "Science Activity Report," but the student makes observations that are more elaborate and precise, and often involve instruments, while the interpretations include conceptual, mathematical or mechanical explanations. In addition, the introduction should explicitly state how the report contributes to the student's answer, at least in part, to the key questions of the lesson. See sample Laboratory Report.

Grades 9-12: There are two points for consideration at this level of development, the content of the study and the format of the report. What follows are guidelines.

First, in terms of the Boston science curriculum, student laboratory investigations should help the student address, even answer, the key questions of the units. By addressing the key questions the laboratory report becomes an integral part (in the sense of coordination and coherence) of the CONTENT as well as the PROCESS of science. Nevertheless, student interest should also play a part in determining the topic of investigations. The balance between these two must be determined by the teacher and student in reference to the content of the curriculum and the student's need to develop scientific competence and confidence.

Second, in terms of the format of the Boston Science Laboratory Report, the following represents a synthesis of several extant formats used by high school and college faculty. Other formats are equally legitimate but it seems that some effort to adopt a common form is preferable at this time in the history of science education in Boston.

Reports should include:

- a. A Title
- b. A Statement of Question or Purpose: For example, "The purpose of this scientific investigation is to determine quantitatively the relationship between the quality (color) and quantity (intensity) of visible light and the rate of growth (biomass/time) of bean seedlings."
- c. An Explanation of the Study Context: In this section the student lists the reasons why the study is undertaken. For example, the study may be an extension of a class laboratory experiment; it may be an investigation that is personally interesting; it may grow out of a question that arose from the student's reading (text, science report); or it may spring from the larger scientific research community where the student participated in a research laboratory program.
- d. Procedures and Materials: The procedures and materials section describes the investigative approach and apparatus used to conduct the investigation or experiment. Unfortunately, in the hands of many school students, this section is overrun with grocery lists of everyday items (e.g. ruler, scotch tape, test tubes) and is short on the specific and essential procedures that guarantee the success of the technique. A well written procedures and materials section is characterized by a succinct style. One good drawing or photograph, with labels, can suffice for many words.
- e. Results: Data are the evidence about which we have some confidence and from which we make our inferences. Students should learn to prize this section of the report. The effective visual display of data, quantitative or qualitative, is an essential scientific skill because the form in which data are arranged contribute greatly to revealing the patterns which illustrate the underlying regularities of nature. Charts and graphs need to be neat, precisely and succinctly labeled, and include only those data which are relevant to the study.
- f. Discussion: This section gives the student's evaluation of the results of the study; her confidence in the evidence; the inferences she made; and the models, whether conceptual, mathematical and/or mechanical, that she invented or employed to give an account of the natural phenomenon as she saw it revealed in the data. Further, it is the place where the student may suggest further questions or even speculate, with care, about next moves. This is also the place where the student address the personal and societal importance of the investigation by answering the questions "What does this mean for you and society?" and "So what?"
- g. References

2. Nature Illustrations

The purpose of illustrations is to increase the student's ability to observe nature precisely and thoroughly. These are fundamental skills for all scientists and skills that can serve in all walks of life. The notebooks of famous scientists are filled with illustrations. The *National Science Education Standards* begins each grade level section of the book with a page taken from a portfolio of school students' illustrations (see attached illustrations).

In addition, young people are exceptionally visually oriented and illustrating can build on this ability. Nature and scientific illustration, it should be noted, is a skill that improves with practice. Although some children appear to have more talent, all children get better at illustrating over time. With regard to science, this simply means that all children can become better observers of nature. Teachers profit, as well, from practicing nature illustrations.

Although it is hard to state what constitutes a good illustration, there are a few criteria that must be kept in mind. Because this is science, a key criteria is accuracy. Accuracy refers to the degree of correspondence between what is emphasized in the drawing and what the phenomenon looks like. For example, for very little children, accuracy might be the ability to choose the right color crayon to fill in a scientific illustration of their banana. Given little children, the banana may be round, long and thin, or even pear shaped. The lack of shape accuracy is not emphasized because it is developmentally inappropriate.

By third grade, however, bananas need to be both yellow (as long as they aren't the green type of bananas) and shaped like a banana. But it may be inappropriate for the child to be asked to color the subtle shades of green, yellow, cream, brown, tan and black that characterize most ripe bananas.

By eighth or ninth grade, if color is the natural feature under inspection, students should be able to execute a rich, holistic, coloring of the banana. A similar developmental scheme can be established for other features of nature such as shapes, orientation, position and numbers of organisms and their parts, and the scale of organisms one to another and to features of their environs.

Furthermore, all efforts to illustrate should teach the student to seek and emphasize the distinguishing feature(s) of the natural object or phenomenon. Examples include a tiger's vertical stripes, the red of a cardinal, the leglessness of a snake, the huge eyes of a dragonfly, or the fact that a fish's tail is vertical whereas a whale's tail is horizontal, or an insect has six legs while a spider has eight and a centipede has many.

3. Photographs of Student Action

Most kids love to show pictures of themselves. This responsibility builds on that enjoyment by asking groups of students to create a photo album of themselves and their classmates engaged in doing science. Photos should include students working with scientific apparatus, participating in field studies, or presenting their scientific studies to other students or family. Photos may also include pictures of students meeting with scientists and engineers (see Protocol for Interviewing, below). These photos can become part of a class portfolio in science. See attached photos for examples.

In addition to the personal collection, photographs build community (it is difficult to take a candid picture of yourself) and lend an air of fun to science classrooms.

A number of teachers at several grade levels in the Boston Public Schools already ask students to take pictures of themselves and their classmates. They report that the students enjoy and profit from the work and that it contributes to an enjoyable and supportive classroom environment.

4. Interview with a Practicing or Applied Scientist; Interviewing an Older BPS Science Student

Interviewing A Practicing Or Applied Scientist:

Students at all levels should see and talk with practicing scientists and people who work in scientific fields. Scientists, engineers, zoo keepers, meteorologists, pet store owners, horticulturists, and farmers, among others, make their living by dealing directly with natural objects and phenomenon. They have interesting stories to tell and can extend school science far beyond the classroom walls.

For the youngest children, an interview may simply be a group interview that takes place in the classroom when a scientist or veterinarian comes to visit. By middle school level, this group interview may suffice, but it is preferable that students work in pairs or small teams to meet an engineer or farmer. In these middle school interviews, whether whole class or small group, students should try to determine what the person does, how science is used in their work, what they think science is all about, and what training or education is needed for their work. This information should be compiled and discussed by the teacher and the class.

High school students should try to travel to the site of the interviewee's work, so they are meeting the person in the context of his or her life's efforts. It is noted, however, that practical circumstances may limit high school students to conducting their interviews as a whole class and in the school building. High school students will be asked to "write-up" the results of the interviews and to send a thank-you note to the interviewee.

At any grade level, photographs of students conducting interviews can contribute to the fulfillment of the photograph responsibility.

Interviewing Older BPS Students:

A second kind of interview includes young students meeting with older BPS students in a formal discussion about particular science activities and projects. Specifically, middle or high school students who have completed high quality science fair projects are invited to present their work to younger students and to respond to questions about their projects (and to science inquiry in general).

5. Summarize an Original Science Report

This requirement exists only at the high school level. Its purpose is to engage the student with original scientific reports or parts of reports, such as especially rich graphs or illustrations. In one form, this report asks the student to identify the evidence, the inferences, and the model which are used by the scientists. In another form, the student is asked to paraphrase or summarize (a very hard exercise, even with the paper's abstract in hand) the content of the scientific paper. For students who may be severely challenged by the level of writing in original scientific papers, other writing may be substituted. For example, there are many popular accounts of nature (Lewis Thomas, Stephen Gould, science sections in newspapers, or even their classmates Science Laboratory Reports), several of which are accessible, even to readers who are below grade level.

6. Documentation of the Extracurricular Science Activity

Students complete a one-page form that asks them to list the activity (date, time, place, or a picture for younger children), briefly describe the activity, and suggest how it contributes to answering one or more of the key questions in their science curricula.

A parent/guardian signs the report and also writes a sentence in which they state what they think their child learned from the activity.

Possible sources of extracurricular science include: Museum of Science, New England Aquarium, Computer Museum, Arnold Arboretum, Boston Park Service Activities, Whale Watch, Trailside Museum, Blue Hills Reservation, Museum of Comparative Zoology, Franklin Park Zoo, Harvard College Observatory.

7. Report on a Book about Scientists or Inventors

In an effort to enrich the student's understanding of the lives of scientists, the historical and social contexts of science, and the nature of science itself, BPS students at all levels are to read or listen to, talk and/or write about books about scientists and inventors.

For grades K-2, the approach to books about scientists is the same as the approach to any other children's literature. Children should be read to; read if they are able; talk; and write, if that is appropriate. Story circles are recommended.

For grade 3-12, children and youth should read books about scientists and inventors. They should discuss these books in small groups and whole class settings. They should be asked to write about what they read. Techniques for engaging students with books about science are more or less the same as those for other forms of literature, bearing in mind that certain literary forms, such as expository prose, are more germane to the purpose of science than, say, epic poetry, because, perhaps, imagination and purpose in science are not the same as imagination and purpose in art.

8. Science Fair/Science Exposition

The purpose of the Science Fair/Exposition Project is similar to that of the Science Activity/Laboratory Report--to promote clear and logical communication about scientific ideas between the person conducting the investigation and his/her audience. However, the Science Fair/Exposition Project goes beyond written reports to include physical demonstrations and verbal support. Projects can be natural extensions of topics covered in class or can focus on other interests of the students, such as an investigation that is personally interesting, a question that arose from the student's reading (text, science report), or the larger scientific research community where the student participated in a research laboratory program.

Grades 3-5: At this level, students' projects (individual, team, or class projects) should explore questions based on their observations of the natural world. Students should gather evidence to answer their questions and may want to use a model to describe and/or analyze the phenomenon they are studying. Projects should be evaluated, but not competitively.

Grades 6-8: Students at this level must complete individual projects (team or whole-class theme-based projects are acceptable if each student has an individually-differentiated task) and should participate in an exhibition with some degree of competition. Students must pose a question or define a problem, propose a likely answer or solution, design and conduct a test or experiment (following humane and safety guidelines) or analytically describe the outcome in the case of non-experimental inquiries, and use the compiled data to evaluate the accuracy of the proposed answer, noting its strengths and weaknesses.

Throughout the project, students should keep a notebook of their progress and find at least three references to support their work. Presentations must incorporate visual aides, including charts or tables of data, and an verbal defense of the methods and results.

Grades 9-10: Students must enter individual projects in an exhibition with a competitive phase. Students must define a problem, articulate a hypothesis, design and conduct a procedure with a control and variable to test the hypothesis (following humane and safety guidelines), and use the compiled data to evaluate the accuracy of the hypothesis and its strengths and weaknesses.

Throughout the project students must record their procedures in a notebook. Students must write a report including at least three references to support their work. Presentations must include visual aides, including charts, tables or graphs, and an verbal defense of the report.

Grades 11-12: The basic format remains the same as the Grades 9-10 project. In addition, experiments should involve multiple variables. The report must include a rationale for the sample size and experimental procedures, an application of statistics (averages, ranges, etc.) to the data, graphs, at least three references (including one from a recent journal), and a revision of the hypothesis or model based on the results of the study. Students should also evaluate competing explanations for their phenomena. Presentations must include visual aides and an oral defense using a theoretical model to explain the results.

District and building guidelines should be consulted for further details.

9. Why This Topic?: Summary or Essay

Students and teachers should know why they are studying what they are studying. To ensure this exploration of the curriculum, students and teachers must examine the reasons why each science topic and related activities are included in the curriculum. Specifically, by the end of the instruction of the topic, each student will address, at developmentally-appropriate levels, the reasons why the topic is studied. Such reasons may include, but are not necessarily limited to, the role of science in society, in the curriculum, and in the lives of students, teachers and others. In addition, the address should directly examine the key questions of each topic.

The “reasons why” will vary by subject, teacher and class, and the address will undoubtedly recur throughout the course of instruction. Teachers are encouraged to promote and allow, without punitive evaluation, “hard questions” about the curriculum, even to the point where the student can present a very strong case for some other form of school science. The point is to emphasize “giving reasons with evidence and probable consequences.” This form of thinking is essential for good science.

Grades K-5: Learners in these grade levels can express their understandings through oral and written statements. These may be limited to one or a few reasons.

Grades 6-8: Learners in these grade levels should organize their understandings in the form of a list of reasons, including evidence and possible outcomes.

Grades 9-12: Learners in these grade levels should prepare their address in the form of an essay, perhaps of 1-2 pages length in ninth and tenth grade and 3-5 pages length in eleventh and twelfth grades. (See the writing standards in the English Language Arts curriculum.)

A Checklist of Inquiry Questions for Teachers of Science*:

The following questions should be frequently heard (from both teachers and students) during science lessons. Some questions may need to be translated to a level that is appropriate for learners of different developmental abilities and knowledge. Rather than teachers directly answering the questions, students' observations should lead them to the answers to the questions.

Description

- What is it?
- What does it do, or what is its function?
- Is it typical?
- Is it real or an artifact? (Is the phenomenon really there or is it created through the experimenter's manipulation?)
- What is its significance/importance/advantage?

Investigation

- Can it be investigated scientifically?
- How can I find out about it?
- How does it work/happen?
- How does/did it begin?
- What causes it to happen? (Is there a cause/effect relationship, or just a correlation?)
- What affects it, and what does it affect? (How does it fit into the whole picture?)

Prediction

- What are the expected results?
- What would happen if _____?
- Has it changed or does it change through time?
- What are its future risks, benefits, or consequences?
- Does it always happen like this?
- Can knowledge about it be used to solve problems or be applied to other situations?

Evidence and Inference

- What is the evidence?
- Are the data/facts about it accurate?
- What inferences can I make from the evidence?
- On what assumptions is the evidence/inference based? Are the assumptions tenable?

Explanation

- What concepts, formulas and/or mechanisms apply to the phenomenon?
- What model can be built or adopted to explain the phenomenon?
- How do I support my position about it?
- What other questions do I need to ask about it?

* BSCS. *Developing Biological Literacy*. (1993). Dubuque, IA: Kendall/Hunt Publishing.

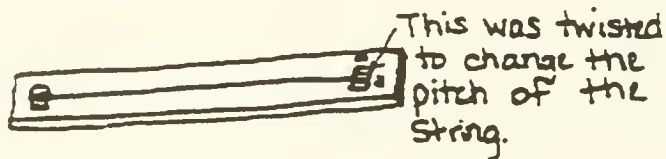
The Boston Science Laboratory Report

Grade 3-5, Example

Title: Tight String and Squeaky Sounds

Observations: I tied a string tightly between two pegs. Then I pulled the string and it made a sound. When I tightened the string by twisting one of the pegs, the pitch was higher.

Data:



The pitch was higher after the peg was twisted.

Interpretation: I think that the tighter the string the higher the pitch is and maybe, the looser the string the lower the pitch is until the string is so loose it doesn't make any sound at all. If I were to do this experiment again, I think I would try it with longer and shorter strings.

The Boston Science Laboratory Report

Grade 6-8, Example

Title: Bending Different Materials: Hooke's Law

Introduction: The purpose of my study is to show that there is a formula for the bending of solid material and how much weight it holds.

Materials: Wood, metal and plastic rulers
Weights from 5 grams to 25 grams
Supports
Ruler for measuring bending

Observations: I suspended each of the rulers, one at a time, between the supports. I measured the distance between the ruler and the top of the table.

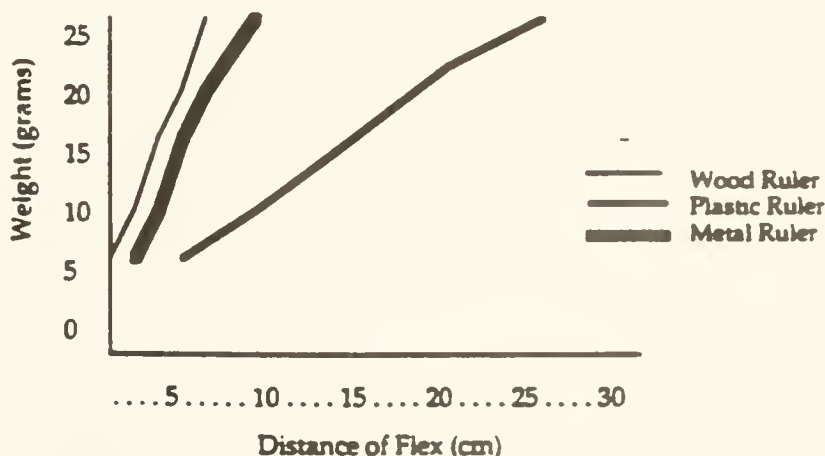
Then I attached each weight to the middle of the ruler. I measured the distance from the ruler to the top of the table. I recorded these distances in a chart (below). I noticed that for each ruler, the heavier the weight, the more the ruler bent. The wood ruler bent the least, the plastic ruler bent the next, and the metal ruler bent the most of all.

Data:

Plastic Ruler		
Weight	Unflexed Distance	Flexed Distance
5 g	40.0 cm	38.0 cm
10 g	40.0 cm	36.2 cm
15 g	40.0 cm	33.9 cm
20 g	40.0 cm	31.8 cm
25 g	40.0 cm	30.0 cm

Metal Ruler		
Weight	Unflexed Distance	Flexed Distance
5 g	40.0 cm	34.8 cm
10 g	40.0 cm	30.3 cm
15 g	40.0 cm	24.9 cm
20 g	40.0 cm	20.0 cm
25 g	40.0 cm	14.7 cm

Wood Ruler		
Weight	Unflexed Distance	Flexed Distance
5 g	40.0 cm	38.7 cm
10 g	40.0 cm	37.5 cm
15 g	40.0 cm	36.4 cm
20 g	40.0 cm	34.9 cm
25 g	40.0 cm	33.8 cm



**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**Social Studies
Kindergarten-Fifth Grade**

**Version 96.1
June 28, 1996**

Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework

Social Studies
Kindergarten-Fifth Grade

Version 2.1
June 18, 1998

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Social Studies in the Boston Public Schools:

Introduction: Core Concept and Goals

The Boston Public Schools support the core concept of the Massachusetts Social Studies Curriculum Framework:

Social Studies education teaches students to become active, responsible participants in their communities, committed to the fundamental values and principles of democracy.

In addition, we are committed to the goals embedded in the six strands included in the state framework. Students will graduate with a strong foundation in each of the following areas:

- **History**: Students will develop a sense of chronology; they will consider people, actions, and events with a critical eye, and an understanding of historical perspective.
- **Geography**: Students will develop a geographical understanding of the world, and the relationships between the physical environment, natural resources, and the human experience.
- **Civics**: Students will gain insight into what power is and how it is legitimized through governance; they will understand the principles of democracy and other systems of governance, and their roles and responsibilities as members of a democratic society.
- **Economics**: Students will explore the important role economics plays in shaping our society; they will understand basic economic theory, the principles of capitalism and other economic systems, and the practical applications of economics in our lives as citizens, workers, and consumers.
- **Cultural Studies**: Students will learn to respect and value a diversity of cultures and to recognize the rich diversity of human experience and expression.
- **World Studies**: Students will learn that as members of the global community, it is important to know and care about what happens in other places.

Finally, we turned to the National Standards for History for guidance, and identified a set of principles of particular importance. We believe that,

- children can, from the earliest elementary grades, begin to build historical understandings and perspectives and to think historically
- history needs to be linked to related studies in geography, civics, economics, social life, religion, science and technology, literature, and the arts
- our standards need to be intellectually demanding, and promote active questioning and learning rather than passive absorption of facts, dates, and names
- our standards need to strike a balance between emphasizing broad themes and probing specific events, ideas, movements, persons, and documents

Current Conditions: Standards and Curriculum Development

The Massachusetts Social Studies Curriculum Framework will not be completed until September, 1996. Consequently, our course sequence, and the grade-level standards detailing content expectations, will not be developed until the 1996-97 school year. The standards in this document focus on the *skills* students will be expected to develop and apply to any content they may study.

In addition, this document includes those products students will be expected to complete, as a condition of grade level and course completion. Each product addresses a set of geography, history, writing, and thinking skills that are relevant to any Social Studies course.

Over the course of this summer, task descriptions will be developed, describing each student product in detail. Teachers, students, and parents may use these task descriptions as instructional tools, and as tools to help them discuss and assess students' work, as it's being developed, and when it's completed. Support will be provided to help teachers become more familiar with the products and task descriptions, to share promising instructional practices, and to help them use the task descriptions most effectively.

We also hope to collect samples of students' work on these products, from schools, on a voluntary basis, at the close of the 1996-97 school year. During the summer of 1997, this student work would be reviewed and discussed by teams of teachers citywide. This process would be designed to:

- refine the performance standards for these products....define precisely what performing at or above standard really means
- identify exemplars of student work "at standard", to be made available to teachers for additional school-based professional development activities
- refine the task descriptions used to develop and assess students' work

A Five Year Plan:

The standards we have set represent expectations we will increasingly meet over the course of next five years. By the close of this decade, students will be required to achieve these standards, as a condition of graduation.

Every school and teacher needs to begin to implement these standards, and the student products, next year. Individual schools should construct careful plans that highlight the steps they will take to reach these standards within five years, and to assess student progress on an annual basis.

Social Studies Standards: Kindergarten

Strand #1: Geography

Standard: Students understand the concepts and details of physical and political geography, and humankind's political, social, and economic relationship with the physical environment.

Students will...

- Identify globes and maps as models and representations of the Earth.
- Use simple location and direction terms (e.g. near, far, above, below, up, down, in front of, behind).
- Identify land and water on a map, globe, or diorama (e.g. hill, lake).
- Identify basic changes of physical features, by season and time (e.g. snow in the winter; dark in the evening).

Strand #2: Chronological Thinking

Standard: Students think chronologically.

Students will...

- Identify basic sequence in daily experiences and in stories, myths, or narratives (first, next, last...).
- Use basic time concepts (yesterday, today, tomorrow...).
- Identify the four seasons and their sequence.
- Identify major holidays by month.
- Name the days of the week in order.
- Name the months of the year in order.
- Use a calendar to locate dates/months.
- Tell time.

Strand #3: Comprehension

Standard: Students comprehend a variety of historical and social studies source documents and materials.

Students will...

- Gather information from pictures, paintings, drawings, and photos, past and present.
- Recall major details of a story or narrative: time, setting, traits, events.

Strand #4: Analysis and Interpretation

Standard: Students engage in historical analysis and interpretation.

Students will...

- Ask questions about the details of a passage.
- Identify main issues and problems.
- Draw comparisons with their own experiences.
- Make observations and draw conclusions from information.
- Identify and express their point of view.

Standard: Students engage in historical analysis and interpretation (continued).

Students will...

- Identify some characteristics of "culture": similarities and differences.
- Interpret photos and pictures.

Strand #5: Research Capabilities

Standard: Students conduct historical and social studies research.

Students will...

- Formulate researchable questions.
- Use the community as a resource.
- Gather information from pictures and photographs.
- Identify the role of the librarian.

Strand #6: Issues Analysis and Decision-Making

Standard: Students engage in historical and social issues analysis and decision-making.

Students will...

- Explain the role and importance of rules and leaders.
- Consider classroom, school, home, and community rules when making decisions.
- Recognize that people have rights and responsibilities that must be respected.
- Explain why and how different people often have different reasons for making decisions.

Kindergarten Social Studies: Student Products

Students will successfully complete at least one of the following products during the 1996-97 school year. Teachers, working in grade level or school-wide teams, will select the product(s) all students will be required to complete.

1. Multicultural Study: People and Events

Students will gather a collection of photos, pictures, and/or drawings of people and events from five very different cultures or countries. Using these photos, pictures, and drawings, students will describe (orally) the people and events, highlighting key characteristics and features.

Objectives: In preparing, completing, and presenting the product, students will.....

- Connect specific photos, drawings, and/or pictures with specific cultures or countries
- Describe some characteristic(s) of each culture, using the photos, pictures and/or drawings
- Make general observations and conclusions about cultures/countries from the information
- Identify some similarities found in two or more cultures
- Identify some differences found in two or more cultures
- Make comparisons between their own culture and other cultures
- Use appropriate language and presentation techniques (see English Language Arts standards: Listening, Speaking, and Presenting").

2. Geography Project: Maps and Dioramas

- a. Students will create a map or diorama with three or more physical features (e.g. landform, body of water). Using different colored paper, clay, or other material, students will construct the map or diorama, and label each of the features (e.g. hill, mountain, river, lake).
- b. Students will locate themselves on their map or diorama and indicate the direction in which they are facing. They will describe (orally) the relationship of the physical features to themselves, using simple directional language (e.g. near/far, in front of/behind).
- c. Given a change of seasons, students will describe how the physical features in the map or diorama will change. Given simple seasonal features (e.g. paper snowflakes, flowers, trees in/out of bloom), students will be able to add the appropriate features to the map or diorama.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Clearly distinguish between the different types of physical features
- Identify the four seasons and their sequence
- Clearly describe changes that occur in the physical features of the environment, and on the map or diorama, with the change of seasons
- Understand maps, globes, and dioramas as models and representations of the earth
- Accurately use simple location and direction terms
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Listening, Speaking, and Presenting).

3. Citizenship Projects: Making and Following Rules

- a. Working with their teacher, students will define a set of classroom rules.
- b. Given a situation from everyday life (e.g. crossing the street, sitting at the dinner table, walking to the cafeteria), students will identify the rules they should follow in that situation.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Participate in the process of establishing the classroom rules
- Identify situations that requires rules
- Give reasons why rules and leaders are important
- Identify responsibilities they have as members of the school community
- Identify the rights of fellow students in their classroom
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

Social Studies Standards: First Grade

The following standards build on those for Kindergarten.

Strand #1: Geography

Standard: Students understand the concepts and details of physical and political geography, and humankind's political, social, and economic relationship with the physical environment.

Students will...

- Trace/describe a route by giving simple directions.
- Use a map key to interpret symbols.
- Identify north/south poles.
- Identify and use cardinal directions.
- Locate the United States on a map or globe.
- Locate and identify major bodies of water in or bordering the U.S.

Strand #2: Chronological Thinking

Standard: Students think chronologically.

Students will...

- Use indefinite time references (now, before, after, then...).

Strand #3: Comprehension

Standard: Students comprehend a variety of historical and social studies source documents and materials.

Students will...

- Classify items by predetermined categories.
- Identify the main idea in a passage.
- Identify cause and effect when made evident.
- Construct simple bar graphs.

Strand #4: Analysis and Interpretation

Standard: Students engage in historical analysis and interpretation.

Students will...

- Predict a further outcome or conclusion to a narrative or story.

Strand #5: Research Capabilities

Standard: Students conduct historical and social studies research.

Students will...

- Use a picture glossary.

Strand #6: Issues Analysis and Decision-Making

Standard: Students engage in historical and social issues analysis and decision-making.

Students will...

- Explain and respect symbols that represent the United States (and other countries).
- Explain some of the characteristics of democracy, and the meaning of certain shared values (e.g. "with liberty and justice for all").
- Identify problems from school that the students can work on together.
- Identify causes of the problems.
- Propose two or three ways to resolve the problems.
- Evaluate the solutions in terms of everybody's needs and interests, and the likely consequences of each.
- Make a decision and take action.
- Evaluate the consequences of the action taken; change if necessary.

First Grade Social Studies: Student Products

Students will successfully complete at least one of the following products during the 1996-97 school year. Teachers, working in grade level or school-wide teams, will select the product(s) all students will be required to complete.

1. Calendar Project: My Favorite Month

- a. Students will construct a calendar for a particular month, including the appropriate days; numbers; local, cultural, and national holidays; classmates' birthdays, and school events. The calendar will include illustrations.
- b. Students will explain in writing a particular holiday or event selected from the calendar, and share the explanation with other students.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Demonstrate a structural understanding of a calendar
- Identify the appropriate holidays, school events and birthdays
- Demonstrate an understanding of the holidays identified on the calendar
- Use basic time concepts (yesterday, today, tomorrow)
- Identify major holidays during the year by month
- Name the days of the week in order
- Name the months of the year in order
- Use the calendar to locate dates/months
- Identify what makes the major holidays/dates significant
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing).

2. Oral History Project: The Family

Students will complete an oral history about an adult member of their (or some other) family. Students will create a poster highlighting the person's characteristics and personal history. They will make an oral presentation describing the poster and including answers to the questions that were asked of the person. (The questions should be collaboratively developed by the students.)

Objectives: In preparing for, completing, and presenting the product, students will.....

- Develop a list of questions to ask an adult member of the family
- Identify the person's most important characteristics
- Develop a sequential narrative of their personal history
- Note and recite the family member's response to the questions that were asked
- Used definite time references (now, before, after, then)
- Draw comparisons with their own experience
- Express thoughts clearly during the presentation
- Use appropriate terms
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Listening, Speaking, and Presenting).

3. Spaces and Shapes: My School

Students create a bird's-eye-view map of their classroom and the floorplan for their school. The maps identifies important features of the classroom and different rooms on their particular floor.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Create a map that was proportionate in size and distance
- Identify the important features of the school in the floor plan
- Identify important features in the classroom
- Indicate directions on the map
- Place the school in relation to the surrounding community
- Explain the map clearly, using appropriate terms

Social Studies Standards: Second Grade

The following standards build on those for grades K-1.

Strand #1: Geography

Standard: Students understand physical and political geography, and humankind's relationship with the physical environment.

Students will...

- Locate major countries around the world.
- Relate a photograph of an area to a map of the same area.

Strand #2: Chronological Thinking

Standard: Students think chronologically.

Students will...

- Establish simple chronology in historical narratives of their own (beginning, middle, end).
- Differentiate broad categories of historical time (past, present, future...).
- Measure calendar time by days, weeks, and months.
- Identify holidays by dates.
- Identify major events by dates.
- Identify examples of change/continuity in their lives, and those of people long ago and today.
- Use simple time lines.

Strand #3: Comprehension

Standard: Students comprehend a variety of historical and social studies source documents and materials.

Students will...

- Read and interpret captions.
- Interpret and compare bar graphs.
- Reconstruct the literal meaning of a short passage, citing key people, events, locations, time, outcomes, and motives, where evident.
- Identify motives, hopes, fears, strengths, and weaknesses in key characters.

Strand #4: Analysis and Interpretation

Standard: Students engage in historical analysis and interpretation.

Students will...

- Identify stated/unstated ideas.
- Distinguish between fact and opinion.
- Identify ways that cultures have been enriched by others.

Strand #5: Research Capabilities

Standard: Students conduct historical and social studies research.

Students will...

- Obtain information from a variety of sources, including an atlas and telephone books.

Strand #6: Issues Analysis and Decision-Making

Standard: Students engage in historical and social issues analysis and decision-making.

Students will...

- Explain, in simple terms, the ways families and cultures influence the decision-making process.
- Explain the importance of voting, majority rule, minority representation, and individual involvement in government and social issues.

Second Grade Social Studies: Student Products

Students will successfully complete at least one of the following products during the 1996-97 school year. Teachers, working in grade level or school-wide teams, will select the product(s) all students will be required to complete.

1. Cultures:

- a. Students will create a product demonstrating they have researched a culture of their choice (including their own). They will research its traditions, three or more famous members of the selected culture (or three of their own ancestors), from this and preceding generations, and the locations of these people's ancestral origins (to the extent they are able). Students will be able to identify these ancestral origins on a world map. The product will include a paragraph.
- b. Students will construct a simple timeline placing their ancestors (or the selected "famous people") and their origins on that timeline, in the proper sequence.
- c. Students will write a note or letter to another child in the classroom, describing the student's own cultural background to the child, and asking the child about his or her culture, traditions, ancestors, and ancestral origins. Students will share what they've learned about the other child with other members of their class.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Identify distinctive characteristics of their culture
- Locate the origins of their ancestors on the map
- Establish a simple chronology in the description of the culture, traditions, ancestors, origins
- Identify major events by broad categories of time and/or dates
- Describe ways in which their culture has enriched their life
- Obtain information from at least two resources
- Present a well-organized, logical explanation of their culture and traditions
- Use appropriate terms
- Identify simple examples of change and continuity in the ways people lived long ago and today
- Explain in simple terms one or two ways family and culture influence people
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

3. The Continents and Oceans: A World Map

Given a blue sheet of paper, an outline of the different continents, and labels with the names of the continents and oceans, students will construct a world map.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Understand simple proportion (e.g., small, large, larger), and simple concepts of distance (e.g., near, far away, very far away)
- Identify continents and oceans on a variety of world maps
- Understand globes and maps as models and representations of earth
- Use simple location and direction terms
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Listening, Speaking, and Presenting).

Social Studies Standards: Third Grade

The following standards build on those for grades K-2.

Strand #1: Geography

Standard: Students understand the concepts and details of physical and political geography, and humankind's political, social, and economic relationship with the physical environment.

Students will...

- Locate states, provinces, and regions.
- Locate and identify the equator, the hemispheres, and the continents.
- Identify islands, rivers, and peninsulas on a map.
- Locate their own community on a map.
- Use number and letter coordinates to locate a place (reading a grid).
- Use a city map, physical map, political map, historical map, and transportation/subway map.
- Use a compass rose.

Strand #2: Chronological Thinking

Standard: Students think chronologically.

Students will...

- Relate day and night to the rotation of the Earth.
- Relate the calendar year to the Earth's revolution around the Sun.
- Speak about calendar time in terms of years, decades, and centuries.

Strand #3: Comprehension

Standard: Students comprehend a variety of historical and social studies source documents and materials.

Students will...

- Identify and compare tables.

Strand #4: Analysis and Interpretation

Standard: Students engage in historical analysis and interpretation.

Students will...

- Propose solutions and predict consequences based on the available information.
- Write a diary entry.
- Write a biographical sketch.
- Write a critical summary.
- Identify and distinguish between cause and effect.
- Ask thought-provoking questions that emerge from the content.

Strand #5: Research Capabilities

Standard: Students conduct historical and social studies research.

Students will...

- Write a report from research.
- Take notes.
- Construct an outline.

Strand #6: Issues Analysis and Decision-Making

Standard: Students engage in historical and social issues analysis and decision-making.

Students will...

- Identify a problem and dilemma from history, home, school, community, and city.
- Identify and analyze the interests, values, and points of view of different people involved in the dilemmas or problem situations.
- Identify causes of the problems or dilemmas.
- Propose alternative ways to resolve the problems or dilemmas.
- Evaluate solutions in terms of ethical considerations, the interests of all parties, plausibility, and the likely consequences of each.
- Formulate positions and courses of action; make recommendations.
- Evaluate the consequences of the actions taken.
- Identify and evaluate others' decisions, actions, and policies from their personal perspective.
- Identify examples of peaceful conflict resolution among people.

Third Grade Social Studies: Student Products

Students will successfully complete at least one of the following products during the 1996-97 school year. Teachers, working in grade level or school-wide teams, will select the product(s) all students will be required to complete.

1. Boston's Neighborhoods: A Collaborative Project

Students, working in teams of two or three, will complete a research product (e.g., a guide or brochure) on a particular Boston neighborhood or section (e.g. Blue Hill Ave., Washington St.).

Objectives: In preparing for, completing, and presenting the product, students will.....

- Locate the neighborhood or section of Boston on a map
- Complete maps indicating the changes in neighborhood over time
- Write a short description of at least three key historical events
- Write a short description of the famous people from the neighborhood or section (at least one man and one woman, of diverse heritage)
- Complete a more detailed biography of one particular famous person
- Write a short description of how and why the inhabitants of the neighborhood or section have changed over time
- Make drawings/pictures of a particular landmark in the neighborhood
- Make drawings/pictures or narrative describing how housing/buildings have changed over time
- Differentiate broad categories of historical time (past, present, future)
- Develop thought-provoking questions that emerged from the study of Boston neighborhood
- Obtain information from a variety of sources
- Identify a problem and/or dilemma from the neighborhood/section of Boston
- Propose alternative ways to solve the problem or dilemma
- Make a significant contribution to a collaborative presentation
- Express information in brochure/guide with clarity and precision
- Organize the written descriptions into proper sections and paragraphs
- Use appropriate terms
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

2. Boston: A Descriptive Timeline

Students will create a descriptive timeline that identifies significant people and events in the history of Boston.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Identify major events and people, by date
- Explain why the people and events on the timeline are significant
- Develop thought provoking questions based on timeline
- Make a link between important events and prominent people
- Accurately identify the sequence of events on timeline
- Space the dates on the timeline with approximate accuracy
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

Social Studies Standards: Fourth Grade

The following standards build on those for Grades K-3.

Strand #1: Geography

Standard: Students understand the concepts and details of physical and political geography, and humankind's political, social, and economic relationship with the physical environment.

Students will...

- Identify and use intermediate directions on a map and globe.
- Determine the direction a river flows by using a map and globe.
- Use a bar scale to determine distance; compare maps at different scales.
- Locate and use coordinates of latitude and longitude.

Strand #2: Chronological Thinking

Standard: Students think chronologically.

Students will...

- Translate dates into centuries.

Strand #3: Comprehension

Standard: Students comprehend a variety of historical and social studies source documents and materials.

Students will...

- Identify and use organizational charts.
- Identify and compare line, picto, and circle, pie graphs, and Venn diagrams.

Strand #4: Analysis and Interpretation

Standard: Students engage in historical analysis and interpretation.

Students will...

- Identify author's point of view.
- Detect bias.
- Recognize persuasion and propaganda.
- Conduct an interview.
- Interpret a flow chart.

Strand #5: Research Capabilities

Standard: Students conduct historical and social studies research.

Students will...

- Interpret political cartoons.
- Obtain information from a variety of sources, including an almanac, encyclopedia, newspapers, periodicals, letters, diaries, journals.

Strand #6: Issues Analysis and Decision-Making

Standard: Students engage in historical and social issues analysis and decision-making.

Students will...

- Identify, analyze, propose and evaluate solutions to, and present and evaluate courses of action in response to a problem and dilemma from history, home, school, community, city, state, and nation.
- Identify and evaluate others' decisions, actions, and policies in a contemporary context.
- Identify examples of peaceful conflict resolution among people, states, and nations.

Fourth Grade Social Studies: Student Products

Students will successfully complete at least one of the following products during the 1996-97 school year. Teachers, working in grade level or school-wide teams, will select the product(s) all students will be required to complete.

1. **Travel Brochure:** Each student will create a travel brochure for a state in the United States.
Objectives: In preparing for, completing, and presenting the product, students will.....
 - Identify and draw important landforms and bodies of water on the state map
 - Draw (or include a picture of) the state flower and flag, including a brief description of their significance
 - Write a brief description of the state's key resources and industries (with some drawing or picture)
 - Cite important events in the history of the state
 - Cite important people in the history of the state
 - Draw a state map to accurate scale
 - Include a coordinate grid (e.g., A-1, C-11), and an index with the coordinates of three or more cities or sites
 - Identify important cities or sites in the state
 - Complete a distance scale on the map with distances from the state's capital to other cities in the United States, including Boston
 - Include travel times, by car (or different type of transportation), from the capital to these cities
 - Complete an historical sketch citing an event and/or people of particular importance;
 - Produce other pictures, drawings and narrative in the travel brochure to attract travelers
 - Obtain information from a variety of sources,, including an almanac, encyclopedia, newspapers, periodicals, letters, diaries, journals
 - Use appropriate terms
 - Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).
2. **Historical Research: An Interview**
Students will research a person of historical significance and conduct an interview with that person. Students will formulate open-ended, issue-oriented questions and answers that particular person would have likely given to the questions.
Objectives: In preparing for, completing, and presenting the product, students will.....
 - Identify the key events or issues that the person needs to address
 - Develop thoughtful questions to ask the person of historical significance
 - Develop appropriate answers that the person might have given to the questions
 - In question-answer format, produce a written dialogue with the person
 - Make connections between historical events, persons and/or issues in the question-answer interview
 - Reflect the views of the person during the interview
 - Provide sufficient background information on the person of historical significance
 - Analyze cause-and-effect relationships during the interview
 - Gather information from at least two sources, including books, periodicals, and primary source documents
 - Explain the information and events in sequence, and provide background to them
 - Consider the person on his/her own terms, including the norms, values and customs of the day, as well as the political and economic conditions
 - Consider multiple perspectives
 - Organize the interview in a logical manner
 - Use terms that are appropriate to the times

- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

3. **Social Issues: Historical Perspectives**

Given an issue, character, or event of particular importance from the curriculum (e.g., Columbus), students will identify the perspectives of different people or groups of people on the issue (e.g. European and Native American). Students will reference at least two sources they consulted to identify these perspectives. Students will conduct a discussion or debate on the issue, role-playing different people and perspectives.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Research an issue, character, and/or event of historical significance
- Identify central questions, events, and issues that need to be addressed
- Develop open-ended, issue-oriented question(s) for a discussion or debate about the issue, character, and/or event
- Develop likely responses from different peoples or groups
- Make connections between historical events, persons and/or issues in the discussion or debate
- Provide sufficient background information on the issue, character, or event of historical significance
- Analyze cause-and-effect relationships during the discussion or debate
- Explain information and events in sequence
- Consider the issue, character, and/or event on its own historical terms, including norms, values and customs of the day, as well as political and economic conditions
- Demonstrate knowledge of the issue, event or character selected for the discussion or debate
- Use appropriate language, conventions and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

Social Studies Standards: Fifth Grade

The following standards build on those for Grades K-4.

Strand #1: Geography

Standard: Students understand the concepts and details of physical and political geography, and humankind's political, social, and economic relationship with the physical environment.

Students will...

- Use maps/telephone books to locate businesses, housing, etc., and speculate on why they are where they are.
- Classify land by types of economic activity (e.g. industrial).
- Identify and use climate/rainfall, population, and time zone maps.
- Maintain weather logs.
- Use various materials to create models of a region.
- Trace the causes of a settlement's growth and decline.
- Show how human actions (war...) effect the control of land and water.
- Show how human actions (e.g. pollution) modify the environment.
- Show how geography affects human systems (e.g. housing).

Strand #2: Chronological Thinking

Standard: Students think chronologically.

Students will...

- Identify B.C. and A.D.
- Recognize that other cultures have different calendars, and why this is so.
- Group historical events by broadly defined eras.
- Construct time lines with proper sequence and spaced intervals and accurately interpret data on time lines.
- Trace patterns of change and continuity in their community, state, and nation.

Strand #3: Comprehension

Standard: Students comprehend a variety of historical and social studies source documents and materials.

Students will...

- Identify primary and secondary sources.
- Put themselves "in the shoes" of those who were there and describe the past as if they were there.
- Identify the central questions the narrative addresses and additional questions that remain.
- Identify the perspectives of various people in or around the event or historical character.
- Identify the norms and values of the day and age.

Strand #4: Analysis and Interpretation

Standard: Students engage in historical analysis and interpretation.

Students will...

- Evaluate arguments based on the evidence.
- Compare and contrast differing sets of ideas, values, personalities, behaviors, institutions, and perspectives.
- Hypothesize the influences of the past.
- Suggest how things might have turned out differently if someone had acted differently
- Examine events and people given the norms and values of the time.
- Seek and organize relevant information.
- Identify obstacles to a desired goal.
- Anticipate other's points of view.
- Identify, examine, and evaluate choices and alternatives.
- Challenge arguments of historical inevitability and identify the role of chance, accidents, and the irrational in shaping history.
- Write persuasively (opinions/editorials).

Strand #5: Research Capabilities

Standard: Students conduct historical and social studies research.

Students will...

- Learn about time and place to construct, evaluate, or consider a story, explanation, or narrative.
- Interrogate the data by checking for credibility, authority, and authenticity; bias, distortion, and propaganda.
- Credit sources appropriately.
- Read and write a bibliography.

Strand #6: Issues Analysis and Decision-Making

Standard: Students engage in historical and social issues analysis and decision-making.

Students will...

- Identify and evaluate others' decisions, actions, and policies in a historical and contemporary context.

Fifth Grade Social Studies: Student Products

Students will successfully complete at least one of the following products during the 1996-97 school year. Teachers, working in grade level or school-wide teams, will select the product(s) all students will be required to complete.

1. Enduring Topics: Conversations Across Time

Students will write a script of a conversation between two famous people in American History representing different time periods. The script will be a conversation in which each character outlines his or her point of view on the same topic or issue. The script will reflect the significance that time has on one's perspective. Students will also summarize the differences between these perspectives and the historical context.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Select an issue or topic which linked two famous people in American history, from two different time periods
- Put themselves "in the shoes" of those two people, as if they were there
- Identify two or more thought-provoking questions related to the topic or issue
- Identify the central question they will discuss
- Identify the norms and values of the time period
- Compare and contrast differing values, ideas, perspectives regarding the question they are discussion
- Provide sufficient background information on the topic/issue and the two historical people
- Identify major events by dates
- Identify patterns of change and continuity between the two eras represented by the selected people
- Obtain information from a variety of sources
- Use appropriate terms
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing: Listening, Speaking, and Presenting).

2. United States Geography:

Given an outline map of the United States, including a distance scale and coordinates, students will identify each state, major rivers and other bodies of water, one or more major city in each state, and major landforms. Students will also be able to identify points on the map given coordinates or coordinates of origin, plus direction and distance.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Compare and contrast various regions of the United States
- Identify the impact that geography has had on developing population centers and economic activity
- Identify the impact that geography had on the "characteristics" of the states and regions
- Understand proportion, directions, distance, and map coordinates, and apply these to scale representations
- Identify states, rivers, bodies of water, landforms, and major cities on a variety of United States maps

3. Biographical Sketch:

Students will prepare a biographical sketch of a famous American, make presentations about this person to other students, and donate a copy of the sketch to the school library as a reference document.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Gather and provide sufficient information on the life and contributions of a famous American
- Identify the major events in the life of the famous American
- Put him/herself "in the shoes" of the person who is the subject of the biographical sketch

Biographical Sketch (continued)

- Identify the key question(s) addressed in the biographical sketch
- Accurately identify the perspectives of various people in or around the historical person of the sketch, about that person
- Identify the norms and values of the day and age of the historical figure
- Write about the major details of the person's biography: time, setting, traits, characteristics
- Identify and include thought-provoking questions that emerge from the biographical sketch
- Gather information from at least two sources, including books, periodicals, and primary source documents
- Explain biographical information and events in sequence
- Describe the past and the famous American in an historical context, considering the norms, values and customs of the day, as well as political and economic conditions
- Use appropriate terms
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

4. Immigration Survey:

Students will develop a survey of the school population designed to identify different countries of origin and, where possible, dates of immigration to the United States. Students will disseminate questions, collect and organize the information in a graph showing where students' families immigrated from and when they immigrated. Students will also display this information on a world map, with data depicting the countries of origin of the largest groups of current immigrants to the United States, and immigration facts from 1900. Each student will interpret and discuss the data in the graph and on the map.

Objectives: In preparing for, completing, and presenting the product, students will.....

- Construct a user-friendly survey
- Gather, interpret, display, and explain the information in the student survey, to his/her classmates, with clarity and precision
- Include an accurate, user-friendly graph (or chart) depicting the data
- Construct a timeline of immigration with proper sequence and space intervals that reflects the immigration pattern over time
- Hypothesize the changes that have occurred in the United States because of immigration
- Put him/herself "in the shoes" of the immigrants and describe their experiences as if they were there
- Develop thoughtful questions related to immigrants and immigration patterns
- Gather information from at least two sources, including books, periodicals, and primary source documents
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

NOTES

CITY OF BOSTON  PRINTING SECTION

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Frameworks
Grades 6-8**

**Version 96.1
June 28, 1996**

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The Boston Public Schools' Learning Standards and Curriculum Frameworks: **Goals and Guiding Principles**

Goals: The Boston Public Schools endorse the broad goals set forth in the Massachusetts Common Core of Learning. Our learning standards and curriculum frameworks are designed to produce classrooms where students are encouraged to:

- Think, Question, and Communicate
- Gain and Apply Knowledge
- Work and Contribute in Meaningful, Purposeful Ways

Students think, question, and communicate to make sense or meaning of their world and experiences. "Thinking includes being able to internalize new ideas and connect them to familiar concepts and prior knowledge." Questioning includes the framing of thoughtful questions, and the pursuit of these questions until the student fully understands. "Communicating means putting learning into the language of speech or writing, and requires reflection in such forms as examination, clarification, analysis, and synthesis."

Students gain and apply knowledge to pursue ideas and experiences, and apply this new knowledge in real life contexts. "This pursuit is interactive by nature. The more experiential it is, the more powerful the learning."

Students' work needs to be "meaningful and purposeful. The process and products of student work (need to be) valued contributions to the school and community. Imbedded in powerful learning experiences are notions of persistence, self-discipline, hard work and effort, and pride in producing quality work." (quotations from The Massachusetts Curriculum Framework, p. 6)

These goals frame the teaching, learning, and assessment process. They are critical to lifelong learning, and essential to gaining students' commitment to the learning process.

Guiding Principles: The following principles are intended to unite the members of the Boston Public Schools community. They extend our goals and provide guidelines for the continuous improvement of teaching and learning in our schools.

The Teaching/Learning Process in the Boston Public Schools:

- Engages all students in challenging, purposeful, and sustained work.
- Focuses on those skills and understandings of fundamental importance to students' success in and outside of school.
- Includes a variety of materials and strategies designed to bring out the best in every child.
- Emphasizes inquiry, problem-solving, discovery, and the real-world application of key concepts, principles, and lessons.
- Immerses students in the work, ideas, beliefs, experiences, and perspectives of people from a broad array of cultures and backgrounds.
- Is developmentally-appropriate.
- Points to the connections within and across disciplines.
- Uses assessment as an ongoing process to improve teaching and learning.
- Utilizes technology to the fullest, to enrich the learning process.
- Is nurtured by learning environments that are safe, disciplined, and focused on teaching and learning.

The Citywide Learning Standards and Curriculum Frameworks: Introduction

The Boston Public Schools Citywide Learning Standards describe what every student in the Boston Public Schools will know and be able to do, as a condition of promotion, course completion, and graduation.

The Curriculum Frameworks identify key products, tasks, and tests students will complete, and key questions they will answer, to demonstrate they have developed the knowledge and skills included in the Learning Standards.

In the Fall of 1995, the Boston Public School Committee and Superintendent Thomas Payzant responded to the emergence of new national and state-level standards, and the absence of clear expectations for Boston Public School students, by calling for the development of citywide learning standards, and curriculum frameworks, for the following core subjects:

- English Language Arts, Mathematics, Science, and Social Studies (to be developed during the 1995-96 academic year)
- World Languages (including English as a Second Language and Native Languages of our target bilingual populations), Health, Physical Education, and the Arts (to be developed in 1996-97)

Over the course of the past six months, the enclosed standards and frameworks have been developed for English Language Arts, Mathematics, Science, and Social Studies. The standards identify what students will know and be able to do as a condition of promotion, course completion, and graduation. The frameworks identify additional objectives; key products, tasks, and tests students will complete; and key questions they will answer, to demonstrate they have developed the knowledge and skills included in the standards.

The standards and frameworks are closely aligned with the Massachusetts Curriculum Frameworks and existing national standards. They have been developed by teachers and administrators from the Boston Public Schools, in collaboration with content area experts from local colleges and universities, parents, students and other members of the Boston Public Schools community.

Why do we need new standards and frameworks?

The Commonwealth of Massachusetts has developed new curriculum frameworks, including standards that define the state's expectations of students throughout the Commonwealth. By the close of this decade, students will be expected to achieve these standards as a condition of graduation from high school.

As of 1995, the Boston Public Schools did not have similar, clearly-defined expectations of our students. The schools were guided by curriculum objectives developed in the early 1980s that needed to be updated and aligned with the new state frameworks. As administrations and priorities changed over the previous decade, as the content base expanded in each subject area, and as technology allowed us to reach further than we may have ever hoped to grasp, our curriculum objectives became more dated. Though many of them are included in the state frameworks, many others were in need of revision.

What do the standards and frameworks include?

The Boston Public Schools Citywide Learning Standards and Curriculum Frameworks include two sections that present the system's expectations of students to increasing degrees of specificity. The first of these sections, the Boston Public Schools' Vision Statements for Elementary, Middle, and High School Graduates, include:

- Academic Skills and Understandings: brief, summative statements, written for important skill and content areas, summarizing key standards for fifth, eighth, and twelfth grade students
- Habits of Mind and Work: key attributes essential for success in any endeavor, at any age, in or outside of school. These habits are closely aligned with the habits promoted in the Massachusetts Curriculum Frameworks. Every teacher shares the responsibility to promote, nurture, and assess students' development of these habits.
- The Graduation Portfolio: brief descriptions of selected products students will be expected to complete, by the end of the fifth, eighth, and twelfth grades, to demonstrate their achievement of grade level standards
- Course and Test Requirements: completion requirements for all students in elementary, middle, and high school, in English Language Arts, Mathematics, Science, and Social Studies

The second of these two sections present the system's expectations of students in much greater detail. This section includes:

- Learning Standards: a description of what students must know and be able to do, in English Language Arts, Mathematics, Science, and Social Studies, at each grade level, and
- Curriculum Frameworks: important elements that provide additional structure to the curriculum, and additional direction to teachers and students alike, including:
 - *Content and Skill Objectives*: more detailed descriptions of each learning standard
 - *Key Questions*: challenging, open-ended questions students will be expected to investigate and answer well, as a condition of promotion and course completion
 - *Student Requirements*: the products, tasks, and tests students will be required to successfully complete, as a condition of promotion and course completion
 - *Task Descriptions*: detailed descriptions of each element included in the required products, explaining in precise terms what is expected of students

Note: The task descriptions are currently under development. They will be finished this summer and piloted during the 1996-97 school year.

Why these standards and frameworks?

Our standards and frameworks have been developed to align with the Massachusetts Curriculum Frameworks and nationally recognized standards in English Language Arts, Mathematics, Science, and Social Studies. We have identified standards that are appropriate for the different grade levels, and that outline expectations comparable to those in high performing districts throughout the Commonwealth. We have considered the expectations of the world of work, including the competencies outlined in the SCANS Report for America 2000, commissioned by the Department of Labor. We have used the College Board's "Academic Preparation for College: What Students Need to Know and Be Able to Do", as a point of departure in considering the expectations of colleges and universities around the country. We have conducted focus groups, including parents, students, teachers, university faculty, and other members of the community, to consider and respond to our draft standards and frameworks, in light of their expectations of students.

We have also considered the materials that are, or will be, available to teachers throughout the grade levels, when considering the content we expect students to master. Though standards and frameworks should not be developed with a particular set of materials in mind, we paid close attention to the exemplary materials that have, and are being developed, particularly in mathematics and science, as we developed our grade-level content standards and frameworks.

In addition, we developed standards and frameworks for each of the content areas that require students to learn how to learn; to ask and answer probing questions; to read analytically; to

write with clarity and precision; to observe, interpret, and appreciate the world around them; to understand and be considerate of others; to look for point of view, as well as bias and prejudice; and to develop deep understandings rather than the superficial recognition of facts.

These are the standards and curriculum frameworks that guide our teachers, other staff, and external partners in identifying, designing, and implementing curriculum, materials, and teaching and learning strategies for all of our students. The standards and curriculum frameworks chart a course to prepare our students for the world of work in the twenty-first century, and for college should they choose to attend.

Who are these standards for?

The standards we have developed are for *all* students. All students will be expected to master the same content, at or above prescribed levels of proficiency. Students with limited English proficiency or with special educational needs will be able to demonstrate achievement of these standards in ways that are different from those employed by regular education students.

Students with limited English proficiency, who have not completed their transition to regular education classes, may study content and complete assessments in their first language. These students will not be required to demonstrate proficiency in English at a level comparable to regular education students. They *will* be required to demonstrate proficiency in their native language, at similar levels of proficiency.

In addition, students who are enrolled in the transitional bilingual education program will be required to demonstrate English language proficiency at the level prescribed in the Boston Public Schools' English as a Second Language standard (to be developed in 1996-97).

For students with identified special educational needs, their individual educational plans will state the learning standards as curriculum goals, along with accommodations, levels of expectations, and performance modifications for how they will meet the standards. There is one set of standards, but how students will demonstrate achievement must be determined on an individual basis that takes into consideration individual learning needs.

A Sense of Balance: Depth and Breadth

We have attempted to balance the often-competing goals of depth and breadth in constructing our standards and curriculum frameworks. On the one hand, we expect students to have the opportunity to pursue topics and ideas until they truly understand them, and to master the processes involved in reaching deep understanding. On the other hand, we have also tried to ensure students have a breadth of knowledge that will allow them to compete with other graduates outside of school, and to pursue meaningful careers and post-secondary studies.

A Work in Progress:

The learning standards and curriculum frameworks were produced through the efforts of hundreds of teachers, administrators, parents, students, university partners, and other community members who participated on subject area teams, task groups, and focus groups. Parent groups and interested individuals also received the documents and gave recommendations. The involvement of parents and other individuals, particularly during the decision-making process on which recommendations to include, was an important component in the development of the standards. Though we are confident we have established rigorous, high-quality standards, and have provided a thoughtful framework to help teachers translate these standards into curriculum, we recognize that many questions remain, that we need to answer during the implementation process. For example:

- Have we struck the proper balance between depth and breadth?
- Do these standards include all that our students must know and be able to do?
Do they include too much?
- Do these standards and frameworks set the proper course to prepare students for the statewide assessments they must pass as a condition of graduation?
- Are the standards and frameworks really helpful to teachers?

- Do we provide enough flexibility to allow students and teachers to pursue valuable, individual interests?
- Can all of this work be completed in the time that is available to us? If yes, how?

Over the course of the next few years, as part of an annual spring review process, we expect to answer these questions (and more), and to make adjustments to improve the standards and frameworks. Just as the process we employed to develop these standards and frameworks engaged hundreds of teachers, parents, students, administrators, and community members, so too will this continuous improvement process.

First Steps: Building the Curriculum

These learning standards and curriculum frameworks set our expectations. They must be brought to life by the creative work of individual teachers. Beginning next year, teachers will begin to expand the standards and frameworks into full curricula, including teacher-developed unit guides and lesson plans, and teacher-selected materials and instructional strategies they feel will best meet our students' needs. As they do so, they will test the value and utility of the standards and frameworks in the only place they really counts: the classroom. Their findings will greatly influence any changes we may choose to make.

Simultaneously, to support the transition from identification of standards and frameworks to actual change in classroom practices, schools and central office will provide professional development opportunities for teachers and staff on curriculum development and instructional assessment practices. Parents will work with the schools and central office to develop and implement a "home" curriculum.

An Open Invitation:

We have embarked upon a course, and a challenge, for which there are few signposts. Our success will depend upon the sustained commitment of everyone engaged in the education of our children, and we want you to be involved. Please send any comments or recommendations you might have to Teaching and Learning Support Services, Boston Public Schools, 26 Court St., 6th Floor, Boston, MA 02108.

The Boston Public Schools' Vision of the Middle School Graduate

The following skills and understandings are standards. Our target is for all middle school graduates to achieve these standards by the year 2001. Every teacher, administrator, and other adult involved in the lives of our students, bilingual, special education, and regular education students alike, shares in the responsibility to ensure that all students achieve these standards.

Academic Skills and Understandings:

- **Reading and Literature:** Students read and understand challenging literature and other materials written at a level of difficulty similar to Mildred Taylor's Road to Memphis and Sports Illustrated; they apply their understandings to real-life situations and challenges.
- **Writing:** Students write well, in various forms, for a variety of audiences and purposes; they understand the writing process and employ it consistently; they understand and employ the conventional elements and formats for a variety of products, including essays, letters and research papers
- **Speaking, Listening, and Presenting:** Students deliver effective oral presentations; they ask and respond to probing questions, listen carefully to others' ideas and perspectives, and look for gaps in reasoning or presentation; they engage in thoughtful discussions with their peers and other audiences, including members of a variety of cultures and socio-economic backgrounds.
- **Mathematics:** Students apply the fundamental concepts from Algebra, Geometry, Probability, Statistics, and Discrete Math, and employ graphing calculators, to complete real-world tasks and the solve real-world problems.
- **Science:** Students use their understandings of scientific procedures and applicable concepts from the physical and life sciences to inform their discussions about social, environmental, and personal concerns; they collect evidence, make inferences, and construct models to explain important concepts.
- **Social Studies/History/Geography:** Students use maps and other geographical representations to compare and discuss the distribution and importance of resources and the effects of geography on people's lives; they apply historical context to the analysis of people and events, and evaluate arguments from two or more perspectives; they understand the basic principles of capitalism; they can compare and contrast the principles of democracy with those of other forms of government.
- **World Languages:** Students use sentences and simple paragraphs to provide and request information, to describe and share ideas, and to express simple needs and emotions; they can read at a beginner's level.
- **Health:** Students apply concepts of health literacy, disease prevention, and risk assessment to the practice of health-enhancing behaviors.
- **The Arts:** Students employ the arts to communicate their beliefs, experiences, ideas, and imagination.
- **Career Exploration:** Students explore a variety of careers, make connections to the academic and social/behavioral requirements of school, and begin to set goals for college and/or career.
- **Research and Study Skills:** Students take notes, organize their work, do their homework, and use the library and other resources outside of school to acquire information.
- **Technology:** Students use technology to gather information, communicate, solve problems, complete and present their work, and increase their capacity to tackle complex tasks.

The Habits of Mind and Work: The following habits are also essential to students' success in middle school. They are the shared responsibility of every teacher, administrator, and other adult involved in the lives of our children.

- **Curiosity and Critical Thinking:** Students listen attentively, observe carefully, and ask thoughtful questions, look for good evidence, and identify gaps in reasoning.
- **Respect for Diversity:** Students recognize and value racial, ethnic, cultural, age, gender, and individual commonalities and differences; they respect other people's perspectives.
- **Consideration and Compassion:** Students treat themselves and others with care and respect; they build trusting relationships; they help, care for, and share with one another.
- **Collaboration:** Students work well with others, give and accept constructive criticism, try to be fair, and solve problems in a peaceful manner.
- **Self-Direction:** Students check their own work, invite the critical response of others, and make appropriate adjustments.
- **Perseverance:** Students work hard until the job is done right, and are patient when the answers do not come quickly.
- **Initiative:** Students try new things, take reasonable risks, and reflect on their successes and mistakes.
- **Courage:** Students stand up for their rights and the rights of others in a positive manner that shows self-respect and respect for others; they resist harmful pressures.
- **Responsibility:** Students set goals and demonstrate responsibility for their future and the future of their families, school, communities, and environment.

The Graduation Portfolio:

Students will complete a portfolio of their work, demonstrating their acquisition of important skills, understandings, and habits. The products in the portfolio will include the following:

1. **Research Paper:** a research paper of three to five pages on a theme that's related to one of the books they have read. Students will:
 - make and support warranted and reasonable assertions about the theme and its development;
 - support their assertions with frequent references to the literature;
 - make perceptive connections between the book and real-life experiences (theirs and others);
 - present sound conclusions;
 - employ proper conventions.
2. **Persuasive Speech:** following the "Lincoln-Douglas" format, each of two students will take a side on a controversial historical topic and prepare a speech to persuade their audience. Students will be prepared to defend both positions. The students will submit supporting materials including source materials (with citations) and an annotated bibliography.
3. **Science Project:** a scientific project that poses one researchable question, records qualitative and quantitative observations and/or experiments, and offers conclusions addressing the question.
4. **Science Presentation:** a presentation in support of the science project.
5. **Letter:** Students write (and send) a letter to a politician, company, or organization about a problem or concern they have with an action or position they have taken. Students describe the action or position, describe their personal position, and request a response to their letter.
6. **Math Projects:** projects that require students to apply fundamental concepts included in the standards to the completion of real-world tasks, and the solution of real-world problems; students will need to employ graphing calculators to complete the tasks and solve the problems.
7. **Physical Challenge:** a certificate of completion of a physical challenge activity.
8. **Collaborative Project:** a collaborative project in which the student applies his or her learnings to educate or influence the opinions and actions of others, or to serve the school or community in some capacity.
9. **Career Exploration:** a project through which the student explores three different careers, including job descriptions, the educational (and other) requirements of each, job and salary prospects, working conditions, and a variety of pros and cons, through readings, interviews, and shadowing experiences, where available.
10. **Autobiography:** a chapter book about particular experiences from important periods of their lives, including experiences that had a strong impact and that taught them important lessons. Special emphasis is placed on students' chapters about their middle school experience. Students complement their written work with pictures, drawings, photos or other works of art.
11. **Work of Art:** an original work, independent or in support of one of the products above.

Each of these products will be assessed using performance standards and rubrics that are familiar to students. The portfolios will be available to students and parents on an ongoing basis, and will serve as the foundation for regular teacher-student-parent conferences. Graduation portfolios will be fully implemented within the next five years. Portfolio entries in World Languages will be developed during 1996-97.

Course and Test Requirements:

English Language Arts: All students will be enrolled in the English Language Arts curriculum during each year in middle school. Students enrolled in Transitional Bilingual Education programs will meet this requirement in accordance with the English-as-a-Second Language (ESL) standards (to be developed during 1996-97)¹. Each student is required to successfully complete all course requirements each year.

Mathematics: Each student will be enrolled in the mathematics curriculum during each year in middle school. Each student is required to successfully complete all course requirements each year.

Science: Each student will be enrolled in the science curriculum for each year in middle school. Each student is required to successfully complete all course requirements each year.

Social Studies: Each student will be enrolled in the social studies curriculum for each year in middle school. Each student is required to successfully complete all course requirements each year.

Habits of Mind and Work: Each student will earn a satisfactory assessment for the habits of mind and work.

1. The State Department of Education is currently developing the assessment protocols for English Language Learners in accordance with the education reform legislation and MGL Chapter 71A.

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework

English Language Arts
Middle School**

**Version 96.1
June 28, 1996**

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English Language Arts: Introduction

The English Language Arts curriculum builds from three beliefs:

- all students need to become independent readers, fluent writers, articulate speakers, skilled listeners, discriminating viewers, and critical thinkers;
- all students need to experience and appreciate the beauty and power of language, to increase their capacity to imagine, to think, to employ language, and to understand; and
- a strong literature program is essential to the development of shared values, social skills, and social responsibility.

The following are key elements of the English Language Arts curriculum:

- *An Integrated Approach:* Skills development is combined with literature and language-rich activities. Students write and talk about what they read and watch; learn writing conventions by editing their own work and the work of others; improve their own writing by studying and modeling effective authors' use of language and conventions; read, write, present, and discuss on a daily basis.
- *An Emphasis on Whole Works of Literature:* Students read, discuss, grapple with, and come to appreciate the power of whole books, on a regular basis.
- *A Common Core of Literature Representing Diverse Cultures:* Students read, discuss, understand, and appreciate a common set of great works of literature:
 - that explore problems and lessons from a variety of perspectives, eras, and places;
 - that engage students in a very personal manner;
 - that model the beauty and power of language; and
 - that help students to increase their understanding of the human experience.
- *A Focus on Inquiry:* Students explore and struggle with fundamental questions about the human experience and the structure of language and literature, and learn to construct their own meaning, and to generate their own answers, while considering the answers of others.
- *An Emphasis on Character Education:* The teaching of shared values, social skills, and social responsibility is an integral part of all literature and language arts activities. Students are encouraged to understand the perspective of others, to explore various ways to resolve conflicts, and to embrace a set of values that are shared by members of our community.
- *Meaningful Applications/Required Products/Portfolios:* Students are required to complete a variety of products that integrate their skills and understandings, are meaningful to them, and are valued in the world outside of school. These products are collected in portfolios available for review by the student, teacher, parents, and others.
- *An Emphasis on Process:* Students learn important reading, writing, organizing, presentation, and thinking strategies applicable to any task in or outside of school.
- *Daily Opportunities to Read, Write, Present, and Discuss:* Students engage in informal writing activities (e.g., journal and notebook entries, personal reflections, and summaries) on an ongoing basis; they have daily opportunities to speak, listen thoughtfully, present, and discuss; they have weekly opportunities to complete formal writing assignments (e.g., picture books, stories, letters, poems, reports, essays, research papers).

An English Language Arts curriculum including these elements produces students who:

- are lifelong readers who love reading and pursue it independently,
- enjoy writing and write with facility and clarity,
- are articulate, confident, and convincing when presenting to others,
- take pride in their work and confidently share it with others.

This approach to English Language Arts is not new. It builds on the work of Boston teachers who have successfully implemented this approach for a number of years. Our standards and curriculum framework have been developed in collaboration with many of these teachers.

English Language Arts: Principles

Reading/Literature:

- Reading is an active, constructive, and creative process that involves distinctive cognitive strategies before, during, and after reading. Good readers access prior knowledge, establish purpose, preview text, generate questions, make predictions, confirm and revise predictions, locate and clarify concepts that cause confusion, take mental or written notes, organize information into categories, and use text features such as illustrations and headings to acquire meaning from print.
- The central focus of primary grade instruction must be reading, and every element of the instructional program in the early grades must be organized to ensure success in reading for every student. From kindergarten through the second grade math, science, social studies, and other activities, should have a language arts base.
- Reading instruction should be flexible and based on individual needs. Some students come to school already reading. Some students experience initial difficulty and will need short-term intervention. Students with continuing reading difficulties will need a long-term, structured program.
- Ongoing assessment is an essential element of instruction. In kindergarten, first, and second grades, the focus of assessment should be on individual diagnosis rather than standardized achievement tests scores. Every kindergarten student needs to develop and be screened for emergent literacy skills with a quick and informal instrument. First graders need to be evaluated using a more systematic process of determining early reading progress. Students in need of additional help should be identified no later than mid-first grade and appropriate support strategies must be available.
- Powerful reading instruction connects literature (fiction and non-fiction), language, comprehension and skill instruction. Skills should not be taught in isolation.
- Phonics is one strategy in a comprehensive approach to reading instruction. Children get a better start in reading if they are taught phonics. Learning phonics helps them to understand the relationship between letters and sounds and to "break the code" that links the words they hear with the words they see in print. Because phonics is a reading strategy, it is best taught in the context of reading, not as a separate subject to be mastered. For the vast majority of students, phonics instruction should be concluded by the end of the third grade.
- Reading comprehension uses literature and language activities that should include many opportunities to read, write, and use oral language.
- A variety of whole class, small group, and individualized instruction is necessary to meet the diverse needs of students. Grouping should be flexible and based on students' interests and developmental needs. Grouping by developmental level for some skills instruction is useful as long as the grouping remains flexible with students reassigned as their needs and the tasks change.
- A strong literature program is essential to individual development and the development of community. Literature provides students with the opportunity:
 - to explore the fundamental questions of humanity;
 - to experience the lives of people from different cultures, eras, places, and economic conditions;
 - to understand their own experiences, feelings, perceptions, and concerns;
 - to recognize the universality of human emotion and experience;
 - to recognize and be sensitive to stereotypes based on race, religion, ethnicity, income, handicap, and gender;
 - to appreciate the beauty and power of language;
 - to appreciate the differences and utility of various genres;
 - to increase their capacity to imagine, to think, to employ language, and to understand.
- There is a core of traditional and contemporary literature that all children should study, understand, and value. This literature must represent and respect our diverse voices, experiences, beliefs and perspectives.

Writing:

- Good writing reflects and stimulates good thinking.
- Writing is a process including opportunities to plan (prewriting); to put initial ideas on paper in some organized context (drafting); to read aloud and reflect on the product, often in collaboration with others (editing); to revise and make corrections (rewriting); and to share the final product with others (publishing).
- The best way to fully develop writing as both an art and a skill is in a context where reading, writing, listening, speaking, viewing, and presenting all reinforce each other and none are taught in isolation.
- Students become competent learners by actively synthesizing, making connections for themselves, speaking their own thoughts and finally crafting those thoughts in writing in a way that is powerful and meaningful for them.
- Writing contributes strongly to reading comprehension; reading aloud contributes strongly to the quality of one's writing.
- Successful writers understand the structure and use of language and employ language creatively and effectively. Grammar and usage must be explicitly taught, from kindergarten through twelfth grade, as part of the writing and reading process. Grammar and usage improve most when students are:
 - regularly exposed to good models of writing, and speaking,
 - asked to study and analyze the grammatical structure and usage in the model,
 - required to write, edit, and rewrite their own work, and the work of others, until the grammar and usage meets the established standard.
- Writing assignments should emphasize writing for real purposes - including letters, notes, editorials, journals - in addition to academic assignments.
- Writing reinforces the idea that language has meaning and it allows students to take ownership of a work's language and structure.
- Spelling development for early readers should take place within the context of reading and writing activities, but other vehicles are also necessary including teaching groups of words that demonstrate sound and spelling patterns.
- Temporary spelling is useful in the primary grades to foster literacy and creativity, not to replace standard spelling.
- Vocabulary development is essential from K-12 to allow students to make specific and effective word choices (diction).

Speaking, Listening, and Presenting:

- Expressing oneself orally is essential to learning.
- Listening is an active, constructive, and creative process that involves distinctive cognitive strategies before, during, and after listening. Good listeners access prior knowledge, establish purpose, make predictions, confirm and revise predictions, generate questions, take mental or written notes, paraphrase content, check for understanding, identify and clarify concepts that cause confusion, and build from the presenter's ideas.
- Students need to learn the different speaking and listening strategies associated with communicating in everyday interpersonal situations; acquiring, interpreting, applying, and transmitting information; evaluating and generating information and ideas according to personal or objective criteria; and communicating for appreciation and entertainment.
- Students will make critical and cultural connections between oral language and written text and structures. This will be reinforced through the study of literature from a variety of cultures.
- Students' language needs to be valued. Students should be encouraged to talk; to listen carefully to one another; to take notes, paraphrase, and summarize what they've heard; and to express their ideas, opinions, and responses.

- Oral language development is important to early literacy. Teachers should engage children in oral language activities by reading to them and through meaningful discussions. Students should be encouraged to read aloud to one another and to discuss what they have read.
- Students need practice, practice, and more practice developing their oral language skills, with a particular emphasis on good diction (pronunciation and elocution).
- Students need practice, practice, and more practice developing their listening skills, with a particular emphasis on understanding what others have said and meant, in the interest of learning from and building on their ideas.

Viewing:

- Viewing "literacy" is an essential competency to be developed by all students.
- Viewing plays, television, video, film, other productions and works of art, as well as natural phenomena is an active and critical process that involves distinctive cognitive strategies before, during, and after viewing. Good viewers access prior knowledge, establish purpose, make predictions, confirm and revise predictions, generate questions, take mental or written notes, paraphrase content, check for understanding, and identify and clarify ideas or concepts that cause confusion.
- Students need to make informed judgments about plays, television, film, and other productions and works of art.

Research & Study Skills: Effective learners....

- Know how to gather and analyze information.
- Make optimal use of all available resources, and most particularly, the library.
- Organize information into categories and outlines.
- Record directions; clarify the task by asking good questions; set goals and timelines; and organize time, materials, and resources to reach these goals in an efficient and effective manner.
- Employ effective strategies to preview text and other materials.
- Employ a variety of study skills including writing-to-learn-strategies (e.g. learning logs, response journals, note taking).

Social Skills:

- A primary goal of education is to promote the development of students' social skills and values.
- One important way students learn to express themselves, and become aware of other people's points of view, is by developing strong perspective-taking skills.
- The development of students' conflict-resolution skills builds on their perspective-taking ability; it enables them to resolve conflicts and promote their own autonomy, while respecting the dignity of those they are in conflict with.
- These two social skills enable students to form healthy relationships in which both persons care for one another and help each other be self-determining.
- The careful development of social skills and values leads to healthy relationships and the improvement of students' literacy skills. The development of students' perspective-taking skills directly influences their ability to speak, listen, read, and write.
- The development of students' social and literacy skills contributes to the prevention of violent behavior on their part, and diminishes their use of alcohol and other drugs.

English Language Arts: Standards and Skill Objectives

The skills identified on the following sheets are important to all secondary school students. Students should develop these skills, to increasing degrees of sophistication, from grade level to grade level.

Every English teacher teaches these skills. Grade level differentiation comes:

- when students apply these skills to works of literature of increasing length and complexity,
- when these works of literature include increasingly sophisticated language,
- when students are asked to make increasingly complex and sophisticated observations, insights and assertions, and
- when students' writings are evaluated for increasing levels of proficiency and increasingly complex structure, language, and ideas.

In most cases the skills on the following chart remain similar across the grade levels. However, we do ask teachers to focus more intensely on developing *particular* skills at different grade levels. These skills constitute our *focus correction areas* for the different grades.

Examples of required and recommended books for each grade level (our "Core Literature": see enclosed) are also included in the skill objectives on the accompanying sheets. These books represent the increasing degree of sophistication and complexity we expect students to manage from grade level to grade level.

Our Focus on Whole Works of Literature

A minimum of four complete books should be taught in every English class each year. These four books should come from the Core Literature list by school year 1998-99 (or earlier, if funds can be identified to purchase these books for each school).

The Core Literature lists include a single required reading for each grade level, and a list of additional recommended readings, differentiated by grade-level to ensure that students are not reading the same books year after year.

Teaching Guides for each of the required readings will be completed this summer. Content Objectives for each book on the Core Literature list will also be completed this summer.

In the Spring of 1997, we expect to assess students' understanding of next year's required reading. Students' ability to perform the tasks included in these skill objectives will greatly influence their level of achievement on that assessment.

- STRAND #1 - READING AND COMPREHENSION STRATEGIES

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #1: Students read and understand challenging materials.

• Students read and understand a variety of grade level materials, including fiction and non-fiction, books, reports, essays, and periodicals. Recommended grade-level works of literature include:

6th Grade: *Roll of Thunder, Hear My Cry*; *So Far from the Bamboo Grove*; *Bridge to Terabithia*; *Going Home*;

Julie of the Wolves

7th Grade: *Homecoming, Outsiders*; *Dragonwings*; *Young Landlords*; *Pacific Crossing*

8th Grade: *Harriet Tubman*; *Dacey's Song*; *Road to Memphis*; *Journey of the Sparrows*; *Dragon's Gate*

9th Grade: *Raisin in the Sun*; *Narrative of the Life of Frederick Douglass*; *Romeo and Juliet*; *Animal Farm*; *Miracle Worker*

10th Grade: *Black Boy*; *Night*; *To Kill a Mockingbird*; *Farewell to Manzanar*; *House on Mango Street*; *Antigone*

11th Grade: *I Know Why the Caged Bird Sings*; *The Crucible*; *The Piano Lesson*; *The Joy Luck Club*; *An Island Like You*

12th Grade: *Autobiography of Malcolm X*; *Hamlet*; *Song of Solomon*; *Woman Warrior*; *Ceremony*; *The House of the Spirits*

Standard #2: Students analyze, interpret, and evaluate literature (fiction & non-fiction). They...

- Paraphrase and summarize and regular intervals
- Identify the author's purpose (to inform, persuade, inspire, entertain)
- Make evaluative analyses of their readings; define and use criteria for judgment
- Analyze readings in terms of causality; make comparisons and contrasts; relate parts to the whole; relate specific examples to general principles
- Infer an author's unstated points
- Identify an author's point of view, bias, and/or prejudice
- Support assertions (about readings) with evidence
- Predict outcomes or logical conclusions, using evidence from the readings
- Confirm or revise predictions on the basis of further reading
- Draw logical conclusions supported by evidence from the content
- Distinguish fact from opinion, assumption, interpretation, or belief
- Formulate probing questions about what they are reading
- Critique a passage, identifying examples of inaccuracy, lack of clarity, and irrelevant, inappropriate, or misleading information
- Compare, contrast, and evaluate different accounts of the same event, or differing views of the same issue
- Make critical distinctions between materials that are clear or unclear, complete or incomplete, accurate or inaccurate, logical or illogical
- Infer traits, feelings, motives, and perspectives of characters, based on what they do and say, and the author's commentary

- STRAND #1 - READING AND COMPREHENSION STRATEGIES (continued)

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #2: Students analyze, interpret, and evaluate literature (continued). They...

- Make evaluative judgments about the actions of characters
- Explain how characters or ideas are developed over the course of a reading
- Infer causal relationships in a plot
- Interpret figurative language

Standard #3: Students understand literary structures. They...

- Know, understand, and use the proper terms associated with the literary genres, including novel, short story, myth, fable, biography, autobiography, diary, editorial, essay, speech, narrative poem, comedy, and tragedy*
- Know, understand, and use the proper terms associated with the elements of a work of fiction, including character (protagonist and antagonist), theme, problem, action, goal, setting, tone (the author's attitude toward a subject), mood (the atmosphere of a passage or work), rising action, climax, falling action, resolution (denouement), and outcome
- Give examples of each of the elements of fiction, drawn from specific readings
- Know, understand, and use the proper terms associated with literary conventions and techniques, including simile, analogy, metaphor, alliteration, personification, hyperbole, paradox, puns, flashback, foreshadowing, imagery, symbolism, and satire
- Identify uses of particular literary conventions and techniques in specific readings
- Distinguish between main plot and subplots
- Distinguish between related supporting ideas or details and unrelated ideas or details
- Identify propaganda
- Make critical comparisons between literary structures of different cultures and analyze where and how they influence American (and other) literature.

* The genres emphasized in particular grade levels may vary by school, depending, in part, on the literature series individual schools have purchased. By the close of the eighth grade, students should meet this standard for all genres.

Standard #4: Students make connections between what they read, their own experiences, and the experiences of others. They...

- Use their prior knowledge and experience to increase their understanding
- Use the features of a book, such as the cover or illustrations, to help construct understanding
- Construct graphic organizers
- Explain the social and historical context of a passage
- Compare their own experiences to those of characters
- Compare the ideas, characters, events, and contexts in their readings to actual or current ideas, people, and events

STRAND #2 - WRITING:

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #1: Students understand the structure of written language and employ this structure effectively.
In their narratives, essays, reports, poems, and all other writings, students...

- Use standard spellings
 - Punctuate sentences properly, including commas, colons, semicolons, apostrophes, quotation marks, periods, exclamation points, and question marks
 - Capitalize correctly
 - Use appropriate abbreviations and contractions
 - Maintain subject-verb agreement and tense coherence
 - Compose complete sentences, simple and compound
 - Compose declarative, interrogative, imperative, and exclamatory sentences
 - Write fully developed paragraphs and multi-page papers, organized in a logical order
 - Use transitional phrases effectively
 - Master the specific *focus correction areas* for their grade level.
 - Understand and employ proper terms when discussing other people's writings, as well as one another's work, including:
 - parts of speech
 - verb tenses and voices (present, past, future, past participle, conditional)
 - the functional elements of a sentence (subject, predicate, dependent and independent clauses)
 - the formal language structure of stories, poems, books, essays...
 - In their discussions about works they read or listen to, students will be able to identify parts of speech and parts of sentences.
- Note:** Grammar should be taught, when needed, for the purpose of improving students' writing, when errors are consistently in evidence. Grammar should not be a separate, isolated topic in the secondary English Language Arts curriculum.

Standard #2: Students understand the writing process and employ the process effectively.

In the process of completing any writing assignment, students...

- Use the five-step (or similar) process of *prewriting, drafting, revising, editing, and "publishing"*
- Discuss one another's work and engage in peer editing

- STRAND #2 - WRITING (continued)

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #3: Students' writing is focused, coherent, and well-organized.

In each of their writings, students...

- Clearly present the purpose and topic of their writing (non-fiction)
- Write purposeful fiction, poetry, other "creative" works
- Use a tone that is appropriate for the intended audience
- Provide an appropriate amount of information (obtained from a variety of sources and points of view, where appropriate)
- Provide an analysis of that information (in essays, research papers, and other critical works)
- Organize events and thoughts in a logical order
- Maintain focus and purpose
- Make choices about language to create the desired effect
- Include a conclusion that brings the work to summation

Standard #4: Students employ a variety of writing formats and utilize technology to complete and enhance their work. They...

- Use conventional formats for written products (e.g. left and right hand margins, adequate spacing between words and lines, paragraph indentation, sufficient "white space")
- Use conventional formatting for friendly and business letters, including envelopes
- Use conventional formatting for research papers, including citations and bibliography
- Word process, desktop publish, and incorporate multi-media, as appropriate, in published reports

- STRAND #3 - VOCABULARY

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard: Students understand the structure of words and demonstrate a strong vocabulary. They...

- Use structural/context clues to determine meanings
- Use a dictionary to find meanings of unfamiliar words, and record their findings
- Use a thesaurus to vary and expand on their own use of language
- Identify synonyms, antonyms, and homonyms for familiar and unfamiliar words
- Use prefixes, suffixes, and root words to determine meaning

- STRAND #4 - ORAL LANGUAGE, LISTENING, AND SPEAKING

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #1: Students engage in effective discussions. They...

- Speak with appropriate loudness, clarity, speed, and phrasing
- Ask and answer concise, clear questions, using full sentences
- Respect the turn-taking rights of others during discussions

Standard #2: Students make effective presentations. They...

- Establish a clear purpose
- Make their points logically and concisely
- Present events or thoughts in a logical sequence
- Provide necessary background information
- Use appropriate language, maintain eye contact, and use visual supports
- Respond appropriately to audience reactions and questions; provide explanations and answer questions
- Recite grade-level material aloud, with fluency and proper emphasis

Standard #3: Students understand, analyze, evaluate, and respond effectively to oral presentations. They:

- Listen to teacher and student presentations. In their notes, students will:
 - identify the speaker's purpose
 - identify key ideas and supporting details
 - identify any gaps in reasoning or presentation
 - distinguish fact from opinion, interpretation, assumption, or belief
 - identify the speaker's bias and point of view
 - infer a speaker's unstated points, assumptions, or purposes
 - draw their own conclusions
 - In discussions and debates, students will:
 - identify important questions that emerge from the presentation
 - ask and discuss key questions
 - exchange ideas and opinions with assurance and consideration
 - probe for clarity, accuracy, and understanding
 - use language and behaviors that are polite and respectful
 - give and accept constructive criticism
- Students will also be able to:
- summarize and paraphrase the previous speakers' key points

- STRAND #4 - ORAL LANGUAGE, LISTENING, AND SPEAKING

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
Standard #4: Students facilitate group discussions. They... • Introduce the subject being taught. <i>(11th/12th Grades)</i> • Ensure all members of the group participate in an orderly manner. <i>(11th/12th Grades)</i> • Ensure participants' turn-taking rights are respected. <i>(11th/12th Grades)</i> • Ensure all members have an opportunity to participate. <i>(11th/12th Grades)</i> • Summarize and re-focus the group at key points in the discussion, and when necessary. <i>(11th/12th Grades)</i> • Bring the discussion to closure and ensure the key points have been identified. <i>(11th/12th Grades)</i>						

- STRAND #5 - RESEARCH, STUDY SKILLS, AND TECHNOLOGY

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
Standard: Students employ effective research and study skills. They... • Follow and give directions • Request information in writing, by telephone, and in person • Vary their reading speed and method in relation to purpose (e.g. skimming and scanning methods) • Write clear, well-organized, and useful notes • Keep a notebook for every course, including notes and assignments • Construct clear, well-organized, and useful outlines • Organize information in categories, rank order, and label groups accordingly • Use book covers, title pages, tables of contents, indexes, and other parts of books to get information • Locate books in the school and other public libraries, using signs, layout maps, card and computerized catalogues • Use a variety of paper, on-line and CD-ROM based reference sources, including encyclopedias, indexes, almanacs, handbooks, newspapers, and other periodicals; use telecommunications to share information and exchange ideas • Identify and use additional sources of information outside of school • Study and prepare for tests in an organized, strategic manner, including the use of study aids • Plan for and complete tests in an effective and strategic manner						

-STRAND #6 - VIEWING

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
Standard: Students understand, analyze, evaluate, and respond effectively to visual presentations. They: • Recount the story elements of television programs, films, and other productions • Identify the intended purposes and messages of advertisements, entertainment programs, and news programs • Identify the format of television programs, films, and other productions • Give reasoned arguments for selecting or rejecting particular television programs, films, and other productions • Identify persuasive techniques and stereotyping used by the media and in advertising • Evaluate what is being viewed • Understand and evaluate the elements of a visual production, including gesture, facial expression, eye focus, stance, tone, volume, pitch, inflection of voice, pace of speech, pausing, and setting • Understand and evaluate the techniques of media production, including lighting, music, camera angles, special and sound effects, fade-outs, voice-over						

-STRAND #7 - PERSPECTIVE-TAKING & CONFLICT-RESOLUTION SKILLS

6th - 8th Grades	9th - 12th Grades
Standard: Students understand and express different points of view. They... • express someone else's view of their relationship • take and understand a third person "viewing" point of view • understand enduring attitudes and values • understand cultural context	Standard: Students understand and express different points of view. They... • locate their own viewpoint in an historical and social context • distinguish between conscious and unconscious reasons for behavior • compare and contrast their own viewpoint with major social viewpoints
Standard: Students employ a variety of conflict-resolution strategies. They... • collaborate with other people and agree on what is most important to each of them • can prioritize items of importance with other people • "split the difference", look for the "common ground"	Standard: Students employ a variety of conflict-resolution strategies. They... • brainstorm new, creative solutions which go beyond their original positions • trust other people and work collaboratively • are flexible, willing to let go of old positions, willing to explore new solutions with others

Student Requirements: English Language Arts, Sixth Grade

As a condition of course completion, students must.....

- Complete all course requirements, as outlined by the teacher.
- Pass the citywide Curriculum Assessment for the course (not a requirement in 1996-97).
- Successfully complete the following, for inclusion in their portfolio*.

(Teachers are encouraged to work with colleagues to combine these with other products from other subject areas.)

- **Reading Reviews:** Students read, understand, and review four books, and at least ten other selections (poems, short stories, articles, plays, etc.), in depth. The books will include literature from at least three different cultures. The other selections will include traditional and contemporary works from at least five different writers (male and female), five genres, and a variety of cultures. To demonstrate understanding of the books (and other selections), students will write their personal reflections on the books, personal questions that have emerged, and answers to the following "key questions":

- How does the author use characters, setting, language, and events to develop the story and lessons?
- What challenges did the main character have to face?
- How are you most like or different than the main character?
- What character do you most identify with? Why? How are you like/different from this character?
- How are some of the events like experiences you have had?
- What was the most memorable event in the story?
- How would you change any part of this story? How would this change affect the story?
- What surprised you in the story? How did this add or take away from the story?
- What lessons did you learn from this story?
- Would you recommend this book to someone else? Why or why not?

(Note: Teachers will select particular key questions students will answer for each book. Students must *be able to* answer all of these questions for each book. Additional book-specific key questions are being written for those books included on the Core Literature list.)

Each student keeps a literature notebook for their required readings. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Autobiography - An Important Period in One's Life:** Students write about one period in their lives and a particular experience during this period that had a strong impact on them. They describe how this experience had a lasting effect on them, and how it taught them a lesson (or lessons) they'll never forget. They express the personal meaning of this experience for themselves. Students may complement their written work with pictures, drawings, photos, etc.
- **Essay - Defending Your Position:** Students write a succinct essay on an issue or theme. The essay should include a description of the issue, a position statement, evidence that supports their position, and a powerful conclusion that convinces the reader the position is sound and well thought out.
- **Letter - A Consumer Complaint:** Students write (and send) a letter to a company or organization in which they explain a problem or concern they have with a product that the company has produced. They explain the purpose of the letter, describe the problem, and ask the company to respond.
- **Presentation:** Students make a 3-5 minute presentation on an issue of importance to them, with the support of index cards. They entertain and answer classmates' questions.
- **Research Paper:** Students complete a research paper on a theme of importance to them that's related to one of their required readings. The paper includes the conventions appropriate to research papers. Students will:
 - make and support a warranted and reasonable assertion about the theme and the text;
 - support their assertion with three or more references to characters and events;
 - reach a sound conclusion building from the evidence they've presented.

Research Paper (continued)

The paper will include the student's summary of the research process. Students will include their reflections on the research process itself, and identify key lessons they have learned.

Original Work: Students write a fictional story, a poem, or a song, paying particular attention to a particular literary convention. Students will present their work in class and discuss the strengths and weaknesses of their work with classmates.

- **Perspective Taking Exercise - A Third Person Viewpoint:** Students, working in pairs, share a personal story related to selected theme or goal from a book they have read in class. Their story includes the point of view of at least one other person. Next, they stand in front of the class "in their own shoes" and tell their story. Then they stand in the shoes of the other person and give his/her view of what happened using the first person voice. The emphasis for grades six through eight is on developing a third person perspective on ones's own experiences.
- **Conflict Resolution Exercise - Using Compromise:** Students discuss a conflict from one of their books with their partners. Next, they roleplay or write about how they would resolve the conflict using the Ask, Brainstorm, Choose (ABC) approach to conflict resolution, with an emphasis on compromise strategies, e.g., you give up something and you get something, or split the difference. The emphasis for grades six through eight is on developing the students ability to prioritize what is important to them and to compromise with others. (see Voices of Love and Freedom Teacher Guides for additional directions)
- * All students are expected to complete Reading Reviews during the 1996-97 school year. In addition, teachers, working together by grade level or school, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, or conflict-resolution; and one additional product that focuses on writing, that all students in that grade or school will successfully complete during the 1996-97 school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives: English Language Arts, Sixth Grade

Overview: Students will discuss and understand the content, themes, and structure of each of the stories, books, poems, articles, and other works they read. Students will reflect on the key concepts included in the literature; deepen their understanding of literary conventions; make connections between their readings, their personal experiences, and the experiences of others; and complete a variety of products to share their new understandings with others.

Core Literature: A Core Literature list, including a single required book for each grade level, and additional recommended books differentiated by grade-level (to ensure that students are not reading the same books year after year), is enclosed. Additional books will be added to the list next year.

A minimum of four complete books should be taught in every English class each year. These four books should come from the Core Literature list by school year 1998-99 (or earlier, if funds can be identified to purchase these books for each school).

Key Concepts: Teachers should identify the key topics, themes, and literary conventions for each book on the core literature list. Students should be able to explain the topics, themes, and conventions, citing examples from the literature and personal experiences. (The following example is for Taylor's Roll of Thunder, Hear My Cry, a book that is included on the Core Literature for the sixth grade.

Topics: Courage

Literary Conventions: Historical Fiction; Sequel; Characterization

Themes*: Students will understand...

- that courage is not restricted to special or famous people.
- that everyone experiences fear, and that fear can be overcome.
- the influences of peer and family pressures, and learn strategies to deal with these pressures.
- the risks and personal costs involved in being or not being courageous.

*Theme: the key lesson(s) the author is trying to convey; the "moral to the story"; the author's position on the book's key topic(s)

Key Questions: Key questions are thought-provoking, often open-ended questions that stimulate students' development of a deep understanding of a work of literature or other reading selection. Students will write and/or present insightful responses to the following key questions about the selections they read, citing references to the work and their own experiences. Teachers may select particular questions to emphasize for each work the students read.

Fiction/Biography/Autobiography:

• **Topic:**

What is this book/chapter all about?

- **Theme:** the key lesson(s) the author is trying to convey; the "moral of the story"; the author's position on the book's key topic(s). Example: "Topic": Friendship; "Theme": Friendship has obligations.

What lessons is the author trying to teach?

How does the theme apply to your life?

Do you agree or disagree with the author's point of view?

• **Plot:**

What are the most memorable or significant events? Why these?

What role did they play in developing the theme?

What's going to happen next? Did it?

• **Characterization:**

Who are the most important characters? What makes them so important?

How do they help to develop the theme?

What are their key characteristics?

• **Conflict:**

What challenges are the key characters wrestling with?

How are they responding to them?

How should they respond? How would you respond?

- **Setting:**
How do location, time, and culture affect the characters and plot?
What role do they play in developing the theme?
Would the story be different in another location, time, or culture?
- **Language:**
How does the author's use of language enhance the story?
- **Connections:**
What comparisons can you make between characters and events in the book/chapter, yourself, and contemporary characters/events you're familiar with?
- **Significance:**
Why is this book important?
Is there anything unique about this book? Is there anything difficult or challenging?
Would you recommend this book to a friend? Why or why not?
- **General:**
What are the most interesting things you learned?
What surprised or amazed you?
How would you change any part of this chapter? How would this change affect the story?

Non-Fiction (Articles/Editorials/Essays/Speeches et al.):

- **Purpose**
What is the author's purpose?
- **Topic**
What is the main topic?
- **Point of View**
What is the author's point of view?
How well does the author present and support his/her point of view?
What facts, opinions, assumptions, interpretations, and/or beliefs does s/he present?
- **Credibility**
Is the author believable?
What important questions remain unanswered?
- **General**
What did you learn?
Would you recommend this reading to someone else? Why or why not?

In addition, teachers should identify particular book/selection-specific "key" questions that are open-ended, thought-provoking and engaging to students, and essential to developing a deep understanding of the major themes or ideas in the reading. Teachers should select particular key questions students will respond to for each selection they read, from those listed above, from others they have developed, and from additional questions students are interested in.

The following sample of book-specific questions is for Taylor's Roll of Thunder, Hear My Cry.

- What is your definition of courage and what lessons about courage is the author trying to convey?
- What have the characters and events in the book taught you about courage?
- What role do family, peers, culture, traditions, and experience play in developing or stifling courage?
- If you were Stacey would you dig the ditch to stop the bus? Why or why not?
- What does Cassie learn in Strawberry?
- Compare the ways in which Uncle Hammer, Mr. Morrison, and Mr. Logan deal with racism. Which man would you be and why?

Student Requirements: English Language Arts, Seventh Grade

As a condition of course completion, students must....

- Complete all course requirements, as outlined by the teacher.
 - Pass the citywide Curriculum Assessment for the course (not a requirement for 1996-97).
 - Successfully complete the following, for inclusion in their portfolio*.
- (Teachers are encouraged to work with colleagues to combine these with other products from other subject areas.)

- **Reading Reviews:** Students read, understand, and review four books, and at least ten other selections (poems, short stories, articles, plays, etc.), in depth. The books will include literature from at least three different cultures. The other selections will include traditional and contemporary works from at least five different writers (male and female), five genres, and a variety of cultures. To demonstrate understanding of the books (and other selections), students will write their personal reflections on the books, personal questions that have emerged, and answers to the following "key questions":

- How does the author use characters, setting, language, and events to develop the story and lessons?
- What challenges did the main character have to face?
- How are you most like or different than the main character?
- What character do you most identify with? Why? How are you like/different from this character?
- How are some of the events like experiences you have had?
- What was the most memorable event in the story?
- How would you change any part of this story? How would this change affect the story?
- What surprised you in the story? How did this add or take away from the story?
- What lessons did you learn from this story?
- Would you recommend this book to someone else? Why or why not?

(Note: Teachers will select particular key questions students will answer for each book. Students must *be able to* answer all of these questions for each book. Additional book-specific key questions are being written for those books included on the Core Literature list.)

Each student keeps a literature notebook for their required readings. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Autobiography _ Two Important Periods in One's Life:** Students write about two periods of their life not included in their sixth grade autobiography, and particular experiences during those periods that had a strong impact on them. They describe how these experiences had a lasting effect on them and taught them a lesson (or lessons) they'll never forget. They express the personal meaning of these experiences for themselves. Students may complement their written work with pictures, drawings, photos, or other works of art.
- **Essay - Taking a Stand:** Students write an essay in which they compare/contrast two points of view on a controversial issue and take a position in support of one of them. Students support their position and reject the alternative with evidence.
- **Letter - An Advocacy Letter to an Elected Official:** Students write (and send) a letter to a politician about a problem or concern they have with an action or position taken by that elected official. They describe what the politician did, what their opinion is of what the politician did, and ask the politician to respond.
- **Presentation:** Students present their response to a "key question" related to one of the required readings, including at least two references to the literature. The presentation will kick-off a discussion of that question by the class. As a part of the presentation, students recite a favorite line or brief passage, from memory, and explain their reasons for selecting it.

- **Research Paper:** Students complete a research paper of no fewer than five pages on a theme that is related to one of their required readings. The paper will include the conventions appropriate to a research paper. Students will:
 - make and support warranted and reasonable assertions about the theme;
 - support their assertions with frequent references to characters, events, and other literary conventions
 - make perceptive connections between the book and real-life experiences (theirs and others);
 - draw sound conclusions that support the author's perspective (as represented in his/her presentation of the theme).
- **Original Work:** Students write a fictional story, a poem, or a song, paying particular attention to two literary conventions. Students will present their work in class and discuss the strengths and weaknesses of their work with classmates.
- **Perspective Taking Exercise - Taking the Viewpoint of a Person You're in Conflict With:** Students, working in pairs, share personal experiences of being in conflict with individuals in their neighborhoods (e.g., storekeepers, neighbor, bus driver). Next, they stand in front of the class "in their own shoes" and tell their story. Then they stand in the shoes of the other people, and give their point of view of what happened, using the first person voice.
- **Conflict Resolution Exercise - Dealing With Gangs:** Students discuss a hypothetical conflict with a gang member with their partners. Next, they roleplay how they would resolve the conflict using the Ask, Brainstorm, Choose (ABC) approach to conflict resolution. They explore what's the best approach to addressing the immediate problem and how what can be done to prevent the problem in the future. (see Voices of Love and Freedom Teacher Guides for additional directions)
- * All students are expected to complete Reading Reviews during the 1996-97 school year. In addition, teachers, working together by grade level or school, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, or conflict resolution; and one additional product that focuses on writing, that all students in that grade or school will successfully complete during the 1996-97 school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives: English Language Arts, Seventh Grade

Overview: Students will discuss and understand the content, themes, and structure of each of the stories, books, poems, articles, and other works they read. Students will reflect on the key concepts included in the literature; deepen their understanding of literary conventions; make connections between their readings, their personal experiences, and the experiences of others; and complete a variety of products to share their new understandings with others.

Core Literature: A Core Literature list, including a single required book for each grade level, and additional recommended books differentiated by grade-level (to ensure that students are not reading the same books year after year), is enclosed. Additional books will be added to the list next year.

A minimum of four complete books should be taught in every English class each year. These four books should come from the Core Literature list by school year 1998-99 (or earlier, if funds can be identified to purchase these books for each school).

Key Concepts: Teachers should identify the key topics, themes, and literary conventions for each book a student reads. Students should be able to explain the topics, themes, and conventions, citing examples from the literature and personal experiences. (The following example is for Walter Dean Myers's *Scorpions*, a book that is included on the Core Literature for the seventh grade.)

Topics: Loyalty, Friendship

Literary Conventions: Characterization

Themes*: Students will...

- come to a deeper understanding of the themes of isolation, friendship, and loyalty
- connect these themes to the present and their personal experiences
- better understand the social and economic issues affecting individuals living in poverty
- understand and debate the importance of environment

***Theme:** the key lesson(s) the author is trying to convey; the "moral to the story"; the author's position on the book's key topic(s)

Key Questions: Key questions are thought-provoking, often open-ended questions that stimulate students' development of a deep understanding of a work of literature or other reading selection. Students will write and/or present insightful responses to the following key questions about the selections they read, citing references to the work and their own experiences. Teachers may select particular questions to emphasize for each work the students read.

Fiction/Biography/Autobiography:

- **Topic:**
What is this book/chapter all about?
- **Theme:** the key lesson(s) the author is trying to convey; the "moral of the story"; the author's position on the book's key topic(s). Example: "Topic": Friendship; "Theme": Friendship has obligations.
What lessons is the author trying to teach?
How does the theme apply to your life?
Do you agree or disagree with the author's point of view?
- **Plot:**
What are the most memorable or significant events? Why these?
What role did they play in developing the theme?
What's going to happen next? Did it?
- **Characterization:**
Who are the most important characters? What makes them so important?
How do they help to develop the theme?
What are their key characteristics?
- **Conflict:**
What challenges are the key characters wrestling with?
How are they responding to them?
How should they respond? How would you respond?

- **Setting:**
How do location, time, and culture affect the characters and plot?
What role do they play in developing the theme?
Would the story be different in another location, time, or culture?
- **Language:**
How does the author's use of language enhance the story?
- **Connections:**
What comparisons can you make between characters and events in the book/chapter, yourself, and contemporary characters/events you're familiar with?
- **Significance:**
Why is this book important?
Is there anything unique about this book? Is there anything difficult or challenging?
Would you recommend this book to a friend? Why or why not?
- **General:**
What are the most interesting things you learned?
What surprised or amazed you?
How would you change any part of this chapter? How would this change affect the story?

Non-Fiction (Articles/Editorials/Essays/Speeches et al.):

- **Purpose**
What is the author's purpose?
- **Topic**
What is the main topic?
- **Point of View**
What is the author's point of view?
How well does the author present and support his/her point of view?
What facts, opinions, assumptions, interpretations, and/or beliefs does s/he present?
- **Credibility**
Is the author believable?
What important questions remain unanswered?
- **General**
What did you learn?
Would you recommend this reading to someone else? Why or why not?

In addition, teachers should identify particular book/selection-specific "key" questions that are open-ended, thought-provoking and engaging to students, and essential to developing a deep understanding of the major themes or ideas in the reading. Teachers should select particular key questions students will respond to for each selection they read, from those listed above, from others they have developed, and from additional questions students are interested in.

The following sample of book-specific questions is for Walter Dean Myer's *Scorpions*.

- How does Jamal's sense of responsibility and loyalty play a role in his decision concerning the Scorpions?
- Why is it that Jamal's feelings of isolation and victimization, as well as his family's economic and social conditions, are not easily remedied?
- Why does Tito continue to befriend Jamal when he knows he is headed for trouble?
- What effect did the shooting have on Tito and Jamal's relationship?
- Why is Mack willing to accept responsibility for the death of Angel and the wounding of Indian?

Student Requirements: English Language Arts, Eighth Grade

As a condition of course completion, students must.....

- Complete all course requirements, as outlined by the teacher.
- Pass the citywide Curriculum Assessment for the course (not a requirement in 1996-97).
- Successfully complete the following, for inclusion in their portfolio*.

(Teachers are encouraged to work with colleagues to combine these with other products from other subject areas.)

- **Reading Reviews:** Students read, understand, and review four books, and at least ten other selections (poems, short stories, articles, plays, etc.), in depth. The books will include literature from at least three different cultures. The other selections will include traditional and contemporary works from at least five different writers (male and female), five genres, and a variety of cultures. To demonstrate understanding of the books (and other selections), students will write their personal reflections on the books, personal questions that have emerged, and answers to the following "key questions":

- How does the author use characters, setting, language, and events to develop the story and lessons?
- What challenges did the main character have to face?
- How are you most like or different than the main character?
- What character do you most identify with? Why? How are you like/different from this character?
- How are some of the events like experiences you have had?
- What was the most memorable event in the story?
- How would you change any part of this story? How would this change affect the story?
- What surprised you in the story? How did this add or take away from the story?
- What lessons did you learn from this story?
- Would you recommend this book to someone else? Why or why not?

(**Note:** Teachers will select particular key questions students will answer for each book. Students must *be able to* answer all of these questions for each book. Additional book-specific key questions are being written for those books included on the Core Literature list.)

Each student keeps a literature notebook for their required readings. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Autobiography - A Book About Yourself:** Students write a chapter book about important periods of their life and particular experiences during these periods that had a strong impact on them and that taught them lessons they will never forget. Special emphasis should be placed on students' chapter about their middle school experience. Students describe the turning points or conflicts in their lives that had particular importance for them. They describe their resolutions to the conflicts, questions or unsettled aspects of their personal story, and they reflect on the meaning of their experiences. Students may complement their written work with pictures, drawings, photos or other works of art.

- **Essay - An Appeal to Your Classmates:** Students write an essay addressed to their classmates in which they appeal to them to support the position taken by the student. In the essay, they compare and contrast two or more points of view on a controversial issue and take a position in support of one of them. Students support their position and reject the alternative with evidence.

- **Letter - Requesting an Interview:** Students, working in pairs, write (and send) a letter requesting an interview with a public official, a businessman or woman, a teacher or administrator they do not know, or some other adult who plays a prominent role in their community (see "Interview" below). The letter states the purpose for requesting the interview and the intention of the students to develop a solution to the problem.

- **Presentation:** Students make a 3-5 minute presentation in support of their essay, with the support of index cards. They entertain and respond to classmates' questions. Their classmates should have the student's essay in advance, critique it using task descriptions they've used and understand, and

prepare questions in advance of the presentation. Classmates will also critique the presentation, using a task description they're familiar with.

- **Research Paper:** Students complete a research paper of no fewer than five pages on a theme that's related to one of their required readings. The paper will include the conventions appropriate to research papers. Students will:
 - make and support warranted and reasonable assertions about the theme and at least one literary convention (e.g., author's development of character or setting, author's use of language);
 - support their assertions with frequent references to the literature;
 - make perceptive connections between the book and real-life experiences (theirs and others);
 - present sound conclusions.
- **Original Work:** Students write a fictional story, a poem, or a song, paying particular attention to three literary conventions. Students will present their work in class and discuss the strengths and weaknesses of their work with classmates.
- **Perspective Taking Exercise - Interview a Public Person:** Each student interviews a public official, a businessman or woman, a teacher or administrator they do not know, or some other adult who plays a prominent role in their community, about a selected controversy. Special attention will be placed on proper protocol, language, and dress. Next, they present to the class the public person's viewpoint about the controversy and their own viewpoint.
- **Conflict Resolution Exercise - Addressing a Public Controversy:** Each student then goes on to use the Ask, Brainstorm, Choose (ABC) approach to define the conflict, propose options for solving the conflict, and decide which option they think will best resolve the conflict. Students focus on compromise options for solving the controversy. Students submit an oral and written summary of the interview and of their proposed solutions. (see Voices of Love and Freedom Teacher Guide for additional directions)
- * All students are expected to complete Reading Reviews during the 1996-97 school year. In addition, teachers, working together by grade level or school, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, or conflict-resolution; and one additional product that focuses on writing, that all students in that grade or school will successfully complete during the 1996-97 school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives: English Language Arts, Eighth Grade

Overview: Students will discuss and understand the content, themes, and structure of each of the stories, books, poems, articles, and other works they read. Students will reflect on the key concepts included in the literature; deepen their understanding of literary conventions; make connections between their readings, their personal experiences, and the experiences of others; and complete a variety of products to share their new understandings with others.

Core Literature: A Core Literature list, including a single required book for each grade level, and additional recommended books differentiated by grade-level (to ensure that students are not reading the same books year after year), is enclosed. Additional books will be added to the list next year.

A minimum of four complete books should be taught in every English class each year. These four books should come from the Core Literature list by school year 1998-99 (or earlier, if funds can be identified to purchase these books for each school).

Key Concepts: Teachers should identify the key topics, themes, and literary conventions for each book a student reads. Students should be able to explain the topics, themes, and conventions, citing examples from the literature and personal experiences. (The following example is for Paterson's *Lyddie*, a book that is included on the Core Literature for the eighth grade.)

Topics: Perseverance (tragic flaw, determination, persistence)

Literary Conventions: The form and nature of tragedy; structure of fairy tales, personification, sequel

Themes*: Students will understand . . .

- that everyone needs perseverance to achieve their goals
- that everyone encounters obstacles, temptations and problems
- the influences of peer and family pressures, and learn strategies they can use to deal with these pressures
- that through perseverance they can achieve a chosen goal (long or short term)

*Theme: the key lesson(s) the author is trying to convey; the "moral to the story"; the author's position on the book's key topic(s)

Key Questions: Key questions are thought-provoking, often open-ended questions that stimulate students' development of a deep understanding of a work of literature or other reading selection. Students will write and/or present insightful responses to the following key questions about the selections they read, citing references to the work and their own experiences. Teachers may select particular questions to emphasize for each work the students read.

Fiction/Biography/Autobiography:

• Topic:

What is this book/chapter all about?

- **Theme:** the key lesson(s) the author is trying to convey; the "moral of the story"; the author's position on the book's key topic(s). Example: "Topic": Friendship; "Theme": Friendship has obligations.

What lessons is the author trying to teach?

How does the theme apply to your life?

Do you agree or disagree with the author's point of view?

• Plot:

What are the most memorable or significant events? Why these?

What role did they play in developing the theme?

What's going to happen next? Did it?

• Characterization:

Who are the most important characters? What makes them so important?

How do they help to develop the theme?

What are their key characteristics?

• Conflict:

What challenges are the key characters wrestling with?

- **Conflict (continued):**
How are they responding to them?
How should they respond? How would you respond?
- **Setting:**
How do location, time, and culture affect the characters and plot?
What role do they play in developing the theme?
Would the story be different in another location, time, or culture?
- **Language:**
How does the author's use of language enhance the story?
- **Connections:**
What comparisons can you make between characters and events in the book/chapter, yourself, and contemporary characters/events you're familiar with?
- **Significance:**
Why is this book important?
Is there anything unique about this book? Is there anything difficult or challenging?
Would you recommend this book to a friend? Why or why not?
- **General:**
What are the most interesting things you learned?
What surprised or amazed you?
How would you change any part of this chapter? How would this change affect the story?

Non-Fiction (Articles/Editorials/Essays/Speeches et al.):

- **Purpose**
What is the author's purpose?
- **Topic**
What is the main topic?
- **Point of View**
What is the author's point of view?
How well does the author present and support his/her point of view?
What facts, opinions, assumptions, interpretations, and/or beliefs does s/he present?
- **Credibility**
Is the author believable?
What important questions remain unanswered?
- **General**
What did you learn?
Would you recommend this reading to someone else? Why or why not?

In addition, teachers should identify particular book/selection-specific "key" questions that are open-ended, thought-provoking and engaging to students, and essential to developing a deep understanding of the major themes or ideas in the reading. Teachers should select particular key questions students will respond to for each selection they read, from those listed above, from others they have developed, and from additional questions students are interested in.

The following sample of book-specific questions is for Paterson's *Lyddie*.

- What is your definition of perseverance and what lessons about perseverance is the author trying to convey?
- What have the characters and events in the book taught you about perseverance?
- What role do family, peers, culture, traditions, and experience play in the development of perseverance?
- How does the perseverance of Lyddie and Charles make it possible for them to exist on the farm by themselves? List the chores they must do in order to survive.
- What is your opinion of Lyddie's final decision to go to college? What kind of student do you think she will be?
- Can Lyddie's parents be considered failures? How is Lyddie different?

**Boston Public Schools
Core Literature List, 1996-97
English Language Arts**

Grade 4

1. Yang the Youngest and His Terrible Ear* - Namioka
2. Abel's Island - Steig
3. Charlotte's Web - White
4. Koya Delaney and the Good Girl Blues - Greenfield
5. My Name is Maria Isabel - Ada
6. Sarah, Plain and Tall - McLachlan
7. Sadako and the 1000 Paper Cranes - Coerr
8. Song of Trees - Taylor
9. The Fighting Ground - Avi
10. The Hundred Dresses - Estes
11. The Magic Shell - Mohr
12. A Boy Becomes a Man at Wounded Knee - Wood

Grade 5

1. Mississippi Bridge* - Taylor
2. Dear Mr. Henshaw - Cleary
3. Felita - Mohr
4. In the Year of the Boar and Jackie Robinson - Lord
5. Journey to Jo'burg - Naidoo
6. Kid in the Red Jacket - Park
7. Crossing the Starlight Bridge - Mead
8. Onion Tears - Kidd
9. Pride of Puerto Rico - Walker
10. Shiloh - Naylor
11. Sojourner Truth, "Ain't I a Woman?" - McKissick
12. Starfisher - Yep
13. The Real Thief - Steig

Grade 6

1. Gift Giver* - Hansen
2. Roll of Thunder, Hear My Cry - Taylor
3. So Far from the Bamboo Grove - Kawashima Watkins
4. Clay Marble - Fong Ho
5. Number the Stars - Lowry
6. Bridge to Terabithia - Paterson
7. Maniac Magee - Spinelli
8. Going Home - Mohr
9. Taking Sides - Soto
10. Guests - Dorris

Grade 7

1. Let the Circle be Unbroken* - Taylor
2. Young Landlords - Myers
3. Taste of Salt - Temple
4. Dragonwings - Yep
5. Goodbye, Vietnam - Whelan
6. Homecoming - Voight
7. Monkey Island - Fox
8. Grab Hands and Run - Temple
9. Among the Volcanoes - Castaneda
10. When Thunders Spoke - Sneve
11. Scorpions - Myers

Grade 8

1. The Giver* - Lowry
2. Hoops - Myers
3. Year of Impossible Goodbyes - Nyul Choi
4. Dragon's Gate - Yep
5. Children of the River - Crew
6. Dickey's Song - Voight
7. Journey of the Sparrows - Buss
8. Lyddie - Patterson
9. Growing Up Inside the Sanctuary of My Imagination - Mohr
10. High Elks Treasure - Sneve
11. Road to Memphis - Taylor
12. Harriet Tubman - Petry

Grade 9

1. A Raisin in the Sun* - Hansberry
2. Narrative of the Life of Frederick Douglass - Douglass
3. Romeo and Juliet - Shakespeare
4. Animal Farm - Orwell
5. The Miracle Worker - Gibson
6. Of Mice and Men - Steinbeck
7. Annie John - Kincaid
8. April and the Dragon Lady - Namioka
9. One Bird - Mori
10. Bless Me, Ultima - Anaya
11. Jesse - Soto
12. Night Flying Woman - Broker

Grade 10

1. Night* - Weisel
2. Black Boy - Wright
3. Antigone - Sophocles
4. To Kill a Mockingbird - Lee
5. The Fire Next Time - Baldwin
6. The Friends - Guy
7. Flowers for Algernon - Keyes
8. Teacup Full of Roses - Mathis
9. Rice Without Rain - Ho
10. The Honorable Prison - de Jenkins
11. The House on Mango Street - Cisneros
12. Mountain Windsong - Conley
13. Smoke Rising - Bruchac
14. Farewell to Manzanar - Wakatsuki Houston

* 1996--97 Citywide Required Reading

**Boston Public Schools
Core Literature List, 1996-97
English Language Arts
(continued)**

Grade 11

1. I Know Why the Caged Bird Sings* - Angelou
2. Their Eyes Were Watching God - Hurston
3. The Crucible - Miller
4. The Piano Lesson - Wilson
5. Death of a Salesman - Miller
6. The Scarlett Letter - Hawthorne
7. My Antonia - Cather
8. China Boy - Lee
9. The Joy Luck Club - Tan
10. An Island Like You - Ortiz Cofer
11. In Nueva York - Mohr
12. Love Medicine - Erdrich

Grade 12

1. Hamlet* - Shakespeare
2. The Autobiography of Malcolm X - Haley
3. Oedipus, the King - Sophocles
4. Song of Solomon - Morrison
5. Incidents in the Life of a Slave Girl - Jacobs
6. The Women of Brewster Place - Naylor
7. Frankenstein - Shelley
8. Love, Stars and All That - Narayan
9. In the Time of the Butterflies - Alvarez
10. Ceremony - Marmon Silko
11. The Grass Dancer - Power
12. The House of the Spirits - Allende

* 1996-97 Citywide Required Reading

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**Mathematics
Middle and High School**

**Version 96.1
June 28, 1996**

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BPS Learning Standards and Curriculum Framework: Mathematics

Introduction:

This document is a guide to the Boston Public Schools mathematics standards. The standards are designed to create consistency and continuity across the grade levels, set parameters for the designation of instructional time, and most importantly, improve the mathematics education of all students in the Boston Public Schools.

Guiding Principles:

There are underlying beliefs and tenets that are central to the vision of mathematical power and the content standards for mathematics education:

- Students should explore mathematical ideas in ways that maintain their enjoyment of and curiosity about mathematics, help them develop depth of understanding, and reflect real-world applications.
- All students should have access to a high quality mathematics program.
- Mathematics learning is a lifelong process that begins and continues in the home and extends to the school and community settings.
- Mathematics instruction should make connections with other disciplines, within mathematics, and to real-world situations.
- Working together in teams and groups enhances mathematical learning, helps students communicate effectively, and develops social and mathematical skills.
- Technology is an essential tool for effective mathematics education.
- Mathematics assessment is a multifaceted tool that monitors student performance, improves instruction, enhances learning, and encourages student self-reflection.

(1996 Massachusetts Mathematics Curriculum Framework)

Core Processes:

The Boston Public Schools Citywide Learning Standards for Mathematics build upon the Massachusetts Mathematics Curriculum Framework's core concept that students develop mathematical power through problem-solving, communication, reasoning, and connections. These concepts are elaborated on further at the beginning of the Pre K-5 and 6-12 Learning Standards.

- Problem Solving: Problem solving is the central focus of mathematics education. Whenever we apply our mathematics knowledge, skills, or experiences to the resolution of a dilemma or situation that is new or perplexing, we are problem solving.
- Communication: Students learn mathematics best when they talk and write about what they are doing. Communication in mathematics promotes mathematical understanding and creates mathematical power.
- Reasoning: Mathematics reasoning is necessary if we are to know and do mathematics. The ability to reason enables students to solve problems in their lives, in and outside of school. Students need to be provided with opportunities to make conjectures, think about and select sensible ways to solve problems, justify their solutions, and share their reasoning with others. They also need to experience, recognize, learn, and use different types of reasoning.
- Connections: Mathematics topics are connected to real life and to one other. Students should understand how mathematics relates to other subject areas. For example, all students should understand the concepts of location and place, each of which is important to both geography and mathematics. Students should appreciate that mathematics is one way of learning about the world, and that it is connected, not isolated, from other ways of learning. Students need to see that many problems in the world, when examined initially, appear quite different; but when we model these same problems mathematically, they have striking similarities.

Organizational Structure:

Our standards are organized by "strands" that are included in the Massachusetts Curriculum Frameworks. These strands include:

1. Number Sense
2. Patterns, Relations, and Functions
3. Geometry, Spatial Sense, and Measurement
4. Probability, Statistics, and Discrete Mathematics

This organization promotes an "integrated" approach to mathematics.

Integrated Mathematics:

An integrated approach to teaching mathematics means making connections within mathematics, as well as to other disciplines and real world situations. In an "integrated mathematics" program, students are taught increasingly sophisticated concepts from different strands of mathematics, including arithmetic, algebra, geometry, probability, and statistics. Measurement is related to number, data, and geometry; and algebraic ideas of patterns and relationships are developed in all areas of mathematics. This process begins in the early grades and continues throughout high school.

Students learn to solve real-life problems that require the integration of skills from two or more of these mathematics strands. Skills, concepts, and procedures are taught through authentic tasks as an integrated whole, not in isolation of one another. Concepts are taught over a long period of time, and connected to a variety of strands.

For example, the concept of fractions should be explored and taught a number of times throughout the school year:

- as parts-to-whole (geometry)
- as the comparison of two quantities (number sense, ratio)
- as the comparison of a particular quantity with a fixed quantity (decimals and percent)
- as the comparison of two comparisons (ratio and proportion)
- through the application of fractions as rates one can investigate (probability and statistics)

When students are exposed to and use fractions in the many ways they are commonly used in the real world, they can become far more proficient problem-solvers.

Beginning in 1998, students throughout Massachusetts will take statewide assessments in mathematics. These assessments will reflect the integrated approach adopted by the state. We are aligning our standards with this approach to prepare our students for these assessments.

Finally, the integrated approach is not new. In most European countries, mathematics is taught in an integrated manner. For example, there is no artificial separation of algebra and geometry. By the same token, math instruction in many of our classrooms is already integrated. Effective teachers, particularly at the elementary and middle school levels, have been using an integrated approach to mathematics instruction for years. For example, even very young children begin to study shapes and sizes during the primary grades, though the language of geometry may not be used. Many Boston middle schools already introduce algebra concepts through an integrated approach. All of this work will continue, and be supported by an integrated approach across all levels.

Key Characteristics:

The following principles define our standards' key characteristics.

- Accessible: Our standards are accessible to the children in the Boston Public Schools.

- Rigorous: Our standards are challenging. In addition to requiring the mastery of facts and procedures, we expect students to know the meaning of computation and operations. Students are required to move beyond the intuitive and concrete level of understanding, to the representational, abstract, application, and communication levels. Mastery is achieved only when a student is able to communicate his or her learning.
- Meaningful: Our standards require students to make meaningful connections between their classroom and the world outside of school. The standards demonstrate to students that learning mathematics is a life-long process, and its purpose is to solve real problems.
- Inquiry-Centered: Our standards promote experiences that are exploratory and discovery-oriented. Students should be encouraged to persist and take risks, be actively engaged, and feel confident in their ability to do mathematics. Though students will make many mistakes along the way, we view these mistakes as opportunities to learn, particularly when they are discussed with other students and the teacher.
- Communication and Reflection-Centered: Mathematics is a language to be learned, with its own vocabulary, syntax, and rules of translation from language to symbol (and vice-versa). We expect students to explore and reflect on concepts and procedures, to express their mathematics understandings clearly, through speech and writing, and to develop their reading skills, as related to mathematics.
- Student Focused/Appropriately Paced: Some students need more time to master the concepts included in our standards. Our standards framework responds to these needs. Every student will graduate with a solid foundation in arithmetic, algebra, geometry, probability, and statistics. Some students will also graduate with a solid foundation in calculus.
- Concrete: Our standards provide teachers and students with concrete example of problems, tasks, and products students will be expected to solve and complete.
- Assessment-Embedded: Assessment is an integral part of the mathematics program, and is aligned with curriculum and instruction. A variety of methods such as performance tasks, projects, observations, discussions, writings, etc. are used to measure and monitor student performance, enhance learning, and improve instruction.

Mathematics assessment also encourages student reflection. Students are expected to take increasing responsibility for organizing and extending tasks into projects and long-term activities. They will select and organize mathematics and resources, extend work to related tasks, review their progress, and check and evaluate their work. Throughout this process, students will develop confidence, perseverance, and persistence by continuing to work on problems that pose challenges.

- Technological: Our standards require students to understand and use appropriate instructional technology, including calculators, computer software, graphing utilities, statistics packages, and different types of measuring devices, to enhance and accelerate mathematics learning, to represent and communicate mathematical ideas, and to make mathematics more accessible to all children. Appropriate technologies will be used in the spirit of manipulatives to make presentations, carry out explorations, and assess mathematical concepts and skills.
- Open-Ended: As children need more and more mathematics to be successful in life, as we learn more about the way children learn mathematics, and as instructional methodologies get better, our standards and curriculum need to keep pace with these changes. Our standards are designed to be implemented, reviewed, and revised, as needed, on an ongoing three to five year cycle.

Core Processes: Mathematics, Grades 6-12

Problem-Solving: Students will...

- formulate and solve real world problems
- solve multi-step problems with multiple solutions or no solution
- develop, use, and evaluate a variety of strategies (i.e. trial and error, break complex problem into series of tasks, etc.) to solve problems
- recognize problems where more information is needed; identify additional information needed
- use problem solving approaches to investigate and understand content from other strands
- select, use, and organize appropriate mathematics, equipment, and materials in solving problems
- develop different mathematical approaches and look for ways to overcome difficulties
- organize and check individual and group work
- apply knowledge, understanding, and skills of mathematics and other disciplines to solve problems of increasing complexity and in a variety of contexts
- use a wide range of methods of computation to solve problems

Reasoning: Students will...

- verify and interpret results
- demonstrate that a problem can be solved in more than one way; justify one's thinking
- draw conclusions using inductive and deductive reasoning
- encounter and consider different lines of mathematical argument: deductive, inductive, quantitative, geometric, spatial, statistical, analogical, etc.
- reason by analogy
- use models, known facts, properties, and relationships to explain thinking
- explain thinking, conjectures, solution processes, and answers
- make generalizations and hypotheses; design ways to test them; analyze results
- generalize solutions to new problem solving situations
- examine own and other's reasoning about mathematics
- present, justify, and defend mathematical thinking (conclusions and solutions)
- interpret and evaluate mathematics that is presented in a variety of forms (numerical, graphical, algebraic, geometrical, etc.)
- appreciate the difference between mathematical explanations and experimental evidence
- appreciate and use logical connectives and hypothetical questions (i.e. "if...then..."), and recognize inconsistencies
- show increasing ability to understand and apply algebraic reasoning processes and spatial reasoning

Communication: Students will...

- develop mathematical communication and skills in the context of other strands
- relate everyday language to mathematical language and symbols
- discuss, illustrate, and write about mathematical concepts and relationships
- use language to reflect on, clarify, and articulate thinking about mathematical ideas and situations
- demonstrate mathematical communication through discussion, representation (i.e. tables, graphs, computer print-outs, symbols, etc.), reading, writing, listening, and responding (individually and in groups)
- discuss work; respond to and ask questions appropriate to given grade level
- develop linguistic, conceptual, and procedural understanding
- express mathematical ideas, skills, and discoveries through conversations, experimentation, drawings, graphs, and abstract and concrete representations
- express mathematical ideas through individual as well as collective efforts
- devise and refine ways of recording
- record and present mathematics in a variety of ways
- understand, use, and present language, notation, and mathematical forms of communication

Connections: Students will...

- discover, use, and apply mathematics in practical tasks, in real-life problems, and within mathematics
- search for patterns while working with numbers, data, shapes, and objects in the environment in an integrated manner
- develop mathematical language, and communicate and reason mathematically within and across strands of mathematics (i.e. relate measurement to data and geometry, ratio and proportion to probability and geometry, etc.)

Integration: Students will...

- connect and relate ideas within different mathematics strands and with other concepts and skills that students are learning
- view mathematics as an integrated whole: make connections within and across strands and to other disciplines
- apply knowledge, understandings, and skills of mathematics and other disciplines to problem solving and real world situations in increasing complexity
- concepts and skills should not be taught in isolation of one another nor in fragmented manner such as rote memorization of facts and procedures
- relate measurement to number, data, and geometry
- develop algebraic ideas of patterns and relationships in all areas of mathematics from K-12
- explore and use algebraic, geometric, and statistical ideas of patterns and relationships in all areas of mathematics

Assessment:

- assessment should be an integral part of curriculum and instruction, and should employ a variety of methods, tasks, instruments, contexts, and problems to assess children's learning and achievement in mathematics

Instruction/Technology:

- create a risk-taking environment where students are encouraged to express ideas and experiment
- use a variety of concrete and pictorial materials for presenting concepts and skills
- use a variety of instructional technologies to represent and communicate mathematical ideas (manipulatives, calculators, and computers; video, CD-ROM, and laser disks in the spirit of manipulatives)
- use calculators and computers as means to explain numbers, as tools for calculating with realistic data, and as manipulatives to conceptualize mathematics
- use appropriate technologies in presentation, explorations, and assessment of mathematical concepts and skills
- use graphing calculators and (grades 7-12) and computer software (spreadsheets, Geometric Supposer, Sketchpad, etc.) to explain number and space, as tools for dealing with realistic data, and to conceptualize concepts

BPS Learning Standards: Sixth Grade Mathematics

Strand #1: Number Sense

Number sense is the ability to understand and use numbers and operations on numbers in computation, measurement, and estimation. (NTCM Standards)

Number Sense and Number Relationships:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand, represent, and use equivalent forms of numbers (integer, fraction, decimal, percent, exponent, and scientific notation) in the real world and in problem-solving situations.	Objectives: Students... • identify and use place value through billions in standard and expanded forms • demonstrate an understanding of exponents (positive powers only) and apply them in meaningful problem solving situations • identify, describe, and apply the fraction, decimal, and percent equivalencies to each other and for the following percents: 1%, 5%, 10%, 25%, 50%, 100% • identify and describe equivalent representations of concepts (i.e. conversions from fractions to decimals to percents) • demonstrate an understanding of the equivalence of fractions through the use of multiple strategies (i.e. equal ratios, multiplication by 1, etc.)
Standard #2: Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • compare integers, decimals, and fractions using number sentences with $<$, $>$, $=$ • read, write, and understand conceptually integers (+ and -), fractions, and decimals • order integers, decimals, and fractions
Standard #3: Understand and apply ratios, proportions, and percents.	Objectives: Students... • understand and apply ratio (and equal ratios) and proportion to solve problems • understand and use maps and scale drawings
Standard #4: Investigate and describe the relationship among fractions, decimals, and percents.	Objectives: Students... • investigate and describe the relationship among fractions, decimals, and percents
Standard #5: Represent numerical relationships in one- and two-dimensional graphs.	Objectives: Students... • graph ordered pairs • convert numerical patterns from tables to graph form (i.e. multiples: things that come in groups)

Number Sense, Computation, and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Compute with whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • use with understanding effective models and processes of computation (mental, oral, written, calculator, computer, etc) • compute with whole numbers, fractions, decimals, and integers
Standard #2: Develop, analyze, and explain procedures for computation and techniques for estimation.	Objectives: Students... • develop and describe multiple strategies for estimating quantities • round to the nearest ten, hundred, thousand, million, billion • round decimals and fractions to the nearest pre-assigned value • use estimation to solve whole number operations; compute and compare the results • use the associative, commutative, and distributive properties to simplify and estimate computations
Standard #3: Develop, analyze, and explain procedures for solving proportions.	Objectives: Students... • use ratio and proportion to solve problems; describe the procedures used
Standard #4: Select and use an appropriate method for computing from among mental arithmetic, paper and pencil, calculator, and computer methods.	Objectives: Students... • use a variety of approaches for computing and solving problems
Standard #5: Use computation, estimation, and proportions to solve problems.	Objectives: Students... • use estimation to solve problems involving money, length, area, perimeter, and volume
Standard #6: Estimate to check the reasonableness of results.	Objectives: Students... • apply number and algorithmic sense, estimation skills, and a variety of methods to check the reasonableness of computations

Number Sense and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and explain the need for numbers other than whole numbers.

Objectives: Students...

- create and solve meaningful problems that require the use of numbers other than whole numbers

Standard #2: Know and use order relations for whole numbers, fractions, decimals, integers, and rational numbers.

Objectives: Students...

- demonstrate an understanding of order and equivalence within decimals (i.e. $.1 = .10 = .100$)
- write a number between two given numbers
- demonstrate an understanding of order of whole numbers, fractions, decimals, and integers: locate them on a number line; locate a number between 2 given numbers
- know and use order of operations including the use of parentheses

Standard #3: Use operations involving fractions, decimals, integers, and rational numbers.

Objectives: Students...

- use operations involving fractions, decimals, and integers

Standard #4: Demonstrate how basic operations are related to one another.

Objectives: Students...

- identify and describe the equivalent representation of procedures (i.e. demonstrate and describe the relationship of addition for whole numbers, fractions, and decimals)
- use concrete and abstract models to understand and describe the mathematical processes underlying the operations of addition, subtraction, multiplication, and division (and their relationship with one another) on fractions, decimals, and integers

Standard #5: Create and apply number theory concepts, including prime numbers, factors, and multiples.

Objectives: Students...

- identify and demonstrate an understanding of common multiples, factors, and primes and composite numbers
- use prime factorization and experimentation to determine the least common multiple (LCM) and greatest common factor (GCF) of whole numbers
- understand and apply divisibility by 2,3,4,5,6,9,10 and multiples of these numbers
- demonstrate an understanding of the periodicity of numbers
- express a number in different bases; convert from one base to another

Strand #2: Patterns, Relations, and Functions

In the middle school years, the study of patterns and functions should focus on the interpretation, analysis, representation, and generalization of relationships. These topics should first be explored as informal investigations, using diagrams and pictorial representations whenever needed. (NCTM Standards)

Patterns and Functions:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Describe, extend, analyze, and create a wide variety of patterns.

Objectives: Students...

- recognize, describe, analyze, extend, and create a wide variety of patterns

Standard #2: Describe and represent relationships with models, tables, graphs, and rules; use sentences and algebraic expressions.

Objectives: Students...

- describe and represent patterns using models, tables, graphs, simple rules, and manipulatives such as pattern and algebra blocks
- locate ordered pairs to graph 2-D figures/data
- plot points on a number line and a coordinate plane
- describe, represent, and compare rates of change using graphs in meaningful contexts (i.e. cost per unit, miles per hour, wages, batting averages) and in discrete (i.e. cost per unit) and continuous (distance per unit of time) settings

Standard #3: Analyze functional relationships to explain how a change in one quantity results in a change in another.

Objectives: Students...

- use iteration as a tool for describing and analyzing functional relationships; represent on a graphing calculator
- investigate and describe the effect of a change in one number on another

Standard #4: Use patterns and functions to represent and solve problems.

Objectives: Students...

- use patterns and functions to solve problems
- use patterns involving integers and positive rational numbers to solve problems

Algebra:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and apply the concepts of variable, expressions, and equation.

Objectives: Students...

- use expressions with variables (i.e. letters, shapes) to develop an understanding of and to describe algebraic relationships, mappings, formulas, expressions, equations, and inequalities

Algebra (continued)

Standard #2: Represent situations and number patterns with tables, graphs, verbal rules, and equations, and explore the interrelationships of these representation.	Objectives: Students... • use and analyze tables and graphs to identify algebraic relationships • represent number patterns with verbal and written rules and standard algebraic notations; describe the properties and relationships
Standard #3: Analyze tables and graphs to identify properties and relationships.	Objectives: Students... • use tables and graphs to identify and describe properties and relationships • develop and describe the concept of proportional relationships between quantities using lines through the origin
Standard #4: Demonstrate an ability to solve linear equations using concrete, informal, and formal methods.	Objectives: Students... • use calculators, computers, concrete manipulatives (i.e. Algebra Lab Gear), and real-life situations to explore/describe linear relationships and to solve simple linear equations • represent real-life situations to solve linear equations (i.e. ratio and proportion: wrist is half neck size; 4 prime numbers <10; $C=15n$ for cost of n items @ \$.15 each)
Standard #5: Describe the strategies used to explore inequalities and nonlinear equations.	Objectives: Students... • use verbal and written means of describing strategies concerning inequalities and nonlinear equations
Standard #6: Apply algebraic methods to solve a variety of real-world and theoretical problems.	Objectives: Students... • manipulate and use algebraic expressions to solve meaningful problems • develop algebraic ideas of patterns and relationships in all areas of mathematics
Standard #7: Construct expressions or equations that model problems.	Objectives: Students... • form and manipulate equations or inequalities to solve problems
Standard #8: Explore and describe a variety of ways to solve equations: include hands-on activities, trial and error, and numerical analysis.	Objectives: Students... • use multiple strategies and tools to solve equations
Standard #9: Know and apply algebraic procedures for solving equations and inequalities.	Objectives: Students... • use algebraic procedures and strategies to solve real-world and mathematical problems using equations and inequalities

Strand #3: Geometry and Measurement

Geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretation can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Identify, describe, compare, and classify geometric figures.	Objectives: Students... • identify, describe, compare, and classify properties of shapes including different types of triangles (scalene, isosceles, right), quadrilaterals, and other polygons • identify point and line symmetry in given polygons • identify, describe, compare, and classify 2-D shapes and 3-D geometric figures • explore, identify, describe spatial relationships and properties of 2-D shapes and 3-D figures using manipulatives and technology
Standard #2: Explore and describe the properties of points, lines, and planes.	Objectives: Students... • measure, describe, classify, and construct angles: acute, obtuse, right, straight, complementary, and supplementary
Standard #3: Visualize and represent (ie build, draw) geometric figures.	Objectives: Students... • identify, name, and construct plane and simple solid figures • identify, describe, and draw congruent and similar figures
Standard #4: Explore and describe transformations of geometric figures.	Objectives: Students... • identify/describe transformations of reflections, translations, slides, flips, and rotations • tessellate shapes across a plane • apply and describe frieze and strip patterns
Standard #5: Represent and solve problems using geometric models.	Objectives: Students... • relate geometric shapes and ideas to the environment, number, and measurement
Standard #6: Understand and apply geometric properties and relationships.	Objectives: Students... • apply the comparison of similar figures and the ratio of their corresponding lengths and areas to solve problems • apply proportional relationships to solve problems

Geometry (continued)

Standard #7: Develop and explain the concept of Pi.	Objectives: Students... • measure the circumferences and diameters of at least five different circular objects and explain how the ratios approach Pi.
Standard #8: Develop and explain the concept of the Pythagorean Theorem.	Objectives: Students... • explore and describe the Pythagorean Theorem using concrete materials (i.e. tangrams, rods, etc.)

Measurement: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Estimate, make, and use measurements to describe and compare phenomena.	Objectives: Students... • describe and use estimates and actual measurements in real-life situations
Standard #2: Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.	Objectives: Students... • select and use appropriate units and tools of measure
Standard #3: Understand the process, structure, and use of systems of measurement.	Objectives: Students... • use measurement ideas in association with the handling of data, shapes, and space and to solve mathematical problems
Standard #4: Describe the meaning of and use perimeter, area, volume, angle measure, capacity, density, weight, and mass as forms of measurement.	Objectives: Students... • describe the meaning of and calculate the area of a rectangle and a triangle; the volume of a cube and a box; and the perimeter of triangles, rectangles, and other simple polygons
Standard #5: Develop, describe, and use the concepts of rates and other derived and indirect measurements.	Objectives: Students... • understand and use maps and scale drawings
Standard #6: Develop and apply formulas and procedures for determining measures to solve problems .	Objectives: Students... • develop and apply formulas for area, perimeter, and volume for standard figures, objects, and for figures derived from combinations of known figures (i.e. a figure made by combining a rectangle and circle)

Strand #4: Probability, Statistics, and Discrete Math

By including statistics (and probability) in the sixth grade curriculum, students review many mathematical ideas, relate mathematics to the real world, and extend their ideas about statistics (and probability). (NCTM Standards)

Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Collect, organize, and describe data systematically.	Objectives: Students... • collect, organize, display, and describe information and data in many forms
Standard #2: Construct, read, and interpret tables, charts, and graphs.	Objectives: Students... • simulate, display, graph, and analyze data using multiple representations such as technology, tables, charts, and graphs • construct and interpret line plots, stem and leaf plots, and frequency distributions
Standard #3: Make inferences and convincing arguments that are based on data analysis.	Objectives: Students... • use the "best line through data" concept to make predictions and to solve problems
Standard #4: Evaluate arguments that are based on data analysis.	Objectives: Students... • evaluate arguments that are based on data analysis
Standard #5: Develop and explain why statistical methods are powerful aids for decision making.	Objectives: Students... • find and describe the mean, median, and mode of data • read and interpret statistical data to make predictions, inferences, and decisions

Probability: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Model situations by devising and carrying out experiments or simulations to determine probabilities.	Objectives: Students... • carry out probability experiments; discuss the results
Standard #2: Construct a sample space to determine probabilities.	Objectives: Students... • determine probabilities of real-world situations such as weather, sports, etc.

Probability (continued)

Standard #3: Describe the power of using a probability model by comparing experimental results with mathematical expectations.	Objectives: Students... • conduct experiments to determine experimental probability and construct a table to establish the theoretical probability and compare the two results
Standard #4: Make predictions that are based on experimental or theoretical probabilities, and determine their reasonableness.	Objectives: Students... • solve problems using probability methods; make and analyze predictions in relation to their reasonableness
Standard #5: Develop and explain an appreciation for the pervasive use of probability in the real world.	Objectives: Students... • cite at least five real-world situations and show how probability is used in each

Discrete Math:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Explore discrete mathematics concepts.	Objectives: Students... • represent data in an organized fashion so that the number of items in a set can be determined • recognize, describe, extend, and create a wide variety of sequences
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BPS Learning Standards: Seventh Grade Mathematics

Strand #1: Number Sense

Number sense refers to an intuitive feeling for numbers and their various uses and interpretations; an appreciation for various levels of accuracy when figuring; the ability to detect arithmetical errors; and a common sense approach to using numbers. (NCTM Standards)

Number Sense and Number Relationships:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand, represent, and use equivalent forms of numbers (integers, fractions, decimals, percents, exponents, and scientific notation) in the real world and in problem solving situations.	Objectives: Students will... • identify and use place value in exponential, standard, and expanded form (including negative, positive, and zero powers) and apply them in meaningful problem solving situations • apply the knowledge of scientific notation
Standard #2: Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students will... • continue to reinforce computations with fractions (decimals, percent, ratio and proportion) and real numbers (integers, rationals, irrationals) • continue to recognize, compare, order and graph integers and rational numbers on a number line; locate a number between two given numbers • find the absolute value of a number
Standard #3: Understand and apply ratios, proportions, and percents.	Objectives: Students will... • understand and apply ratio and proportion to probability and geometry to solve numerical and algebraic problems
Standard #4: Investigate and describe the relationship among fractions, decimals, and percents.	Objectives: Students will... • continue to investigate and describe the relationship among fractions, decimals, and percents
Standard #5: Represent numerical relationships in one- and two-dimensional graphs.	Objectives: Students will... • use a graphing calculator to graph ordered pairs and convert numerical patterns from tables to graph form

Number Sense, Computation, and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Compute with whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students will... • understand, use and perform four fundamental arithmetic operations on whole numbers, fractions, decimals, percents and integers; use order of operations
Standard #2: Develop, analyze, and explain procedures for computation and techniques for estimation.	Objectives: Students will... • develop and describe multiple strategies for estimating quantities • estimate the outcome of operations on whole numbers, fractions, decimals and percents and scientific notation
Standard #3: Develop, analyze, and explain procedures for solving proportions.	Objectives: Students will... • recognize and use ratio and proportion in practical situations
Standard #4: Select and use an appropriate method for computing from among mental arithmetic, paper and pencil, calculator, and computer methods.	Objectives: Students will... • use a variety of approaches for computing and solving problems (including the graphing calculator) • write number stories involving various operations in the context of measurement, geometry, probability, and statistics
Standard #5: Use computation, estimation, and proportions to solve problems.	Objectives: Students will... • use estimation to solve problems involving money, length, area, perimeter, and volume
Standard #6: Estimate to check the reasonableness of results.	Objectives: Students will... • apply a variety of methods to check reasonableness of results

Number Systems and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and explain the need for numbers other than whole numbers.	Objectives: Students... • create and solve meaningful problems that require the use of numbers other than whole numbers
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Number Systems and Number Theory (continued)

Standard #2: Know and use order relations for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... differentiate between types of numbers (whole and real numbers, integers, rationals and irrationals)
Standard #3: Use operations involving fractions, decimals, integers, and rational numbers.	Objectives: Students... use operations involving fractions, decimals, and integers and rational numbers
Standard #4: Demonstrate how basic operations are related to one another.	Objectives: Students... - continue to identify and describe the equivalent representation of procedures (i.e. demonstrate and describe the relationship of addition for whole numbers, fractions, decimals) - continue to use concrete and abstract models to understand and describe the mathematical processes underlying the operations of addition, subtraction, multiplication, and division (and their relationship with one another) on fractions, decimals, and integers
Standard #5: Create and apply number theory concepts, including prime numbers, factors, and multiples.	Objectives: Students... - find and use common multiples, factors, prime and composite numbers - use divisibility tests (2,3,4,5,6,8,9,10,11 and their multiples)

Strand #2: Patterns, Relations, and Functions

Mathematicians observe patterns; they conjecture, test, discuss, verbalize, and generalize these patterns. Through this process, they discover the salient features of the pattern, construct understanding of concepts and relationships, develop a language to talk about the pattern, integrate and discriminate between the pattern and other patterns. When relationships between quantities in a pattern are studied, knowledge about important mathematical relationships and functions emerges. (NCTM Standards)

Patterns and Functions: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, extend, analyze, and create a wide variety of patterns.	Objectives: Students... - describe and develop patterns using numbers, variables, and geometric figures - develop patterns into algebraic forms (functions, relations, general term)

Patterns and Functions (continued)

Standard #2: Describe and represent relationships with models, tables, graphs, and rules; use sentences and algebraic expressions.	Objectives: Students... • describe and represent patterns using models, tables, graphs, simple rules, and manipulatives such as Algebra Lab Gear
Standard #3: Analyze functional relationships to explain how a change in one quantity results in a change in another.	Objectives: Students... • develop and apply the idea of a function as a certain sort of relationship between quantities
Standard #4: Use patterns and functions to represent and solve problems.	Objectives: Students... • use patterns and functions to solve problems • use patterns involving integers and positive rational numbers to solve problems

Algebra:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and apply the concepts of variable, expressions, and equation.	Objectives: Students... • develop and apply key concepts such as variable, equivalence, order, and inverse in the context of number, algebra, and geometry; use order of operations on algebraic expressions
Standard #2: Represent situations and number patterns with tables, graphs, verbal rules, and equations, and explore the interrelationships of these representations.	Objectives: Students... • use and analyze tables and graphs to identify algebraic relationships • represent number patterns with verbal and written rules and standard algebraic notations: describe the properties and relationships • use and find a function rule from a table of data, graphs and rules
Standard #3: Analyze tables and graphs to identify properties and relationships.	Objectives: Students... • use tables and graphs to apply the properties of addition, subtraction, multiplication, and division

Algebra (continued)

Standard #4: Demonstrate an ability to solve linear equations using concrete, informal, and formal methods.	Objectives: Students... • use calculators, computers, concrete manipulatives (i.e. Algebra Lab Gear), and real-life situations to explore and describe linear relationships and to solve simple linear equations • represent real-life situations to solve linear equations • develop an understanding of how algebra is used in the real world (e.g., as it relates to ratio and proportion)
Standard #5: Describe the strategies used to explore inequalities and nonlinear equations.	Objectives: Students... • solve and graph solutions of inequalities
Standard #6: Apply algebraic methods to solve a variety of real-world and theoretical problems.	Objectives: Students... • understand and use proportional reasoning in real-life situations such as: scale drawing, rate and speed • recognize and write in exponential notation • recognize and use the commutative, associative, distributive properties of addition and multiplication in abstract algebra form
Standard #7: Construct expressions or equations that model problems.	Objectives: Students... • form and manipulate equations or inequalities to solve problems involving geometry, probability, and statistics
Standard #8: Explore and describe a variety of ways to solve equations: include hands-on activities, trial and error, and numerical analysis.	Objectives: Students... • use multiple strategies and tools to solve equations
Standard #9: Know and apply algebraic procedures for solving equations and inequalities.	Objectives: Students... • apply algebraic procedures for solving equations and inequalities

Strand #3: Geometry and Measurement

The study of geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretation can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Identify, describe, compare, and classify geometric figures.	Objectives: Students... • identify and draw the basic geometric figures (point, line, plane, intersect, line segment, endpoint, ray, and angles, vertex of an angle and side of an angle)
Standard #2: Explore and describe the properties of points, lines, and planes.	Objectives: Students... • identify and draw parallel, perpendicular, and transversal lines, and explore the relationships between the angles formed by these lines • identify, draw, and describe line segments, rays, angles using letters and measuring angles with a protractor
Standard #3: Visualize and represent (i.e. build, draw) geometric figures.	Objectives: Students... • classify and draw polygons and circles (center, diameter, perimeter) • identify solid shapes (measure to quarter units and one tenth units)
Standard #4: Explore and describe transformations of geometric figures.	Objectives: Students... • continue to explore, identify and use transformations such as flips, turns, rotations, translations,(e.g., wall paper patterns) and composite transformations
Standard #5: Represent and solve problems using geometric models.	Objectives: Students... • relate geometric shapes and ideas to the measurement, ratio and proportion
Standard #6: Understand and apply geometric properties and relationships.	Objectives: Students... • recognize and draw symmetric, similar and congruent figures and solve problems using similarity of figures
Standard #7: Develop and explain the concept of Pi (Π).	Objectives: Students... • measure the circumferences and diameters of at least five different circular objects and explain how the ratios approach Pi.

Geometry (continued)

Standard #8: Develop and explain the concept of the Pythagorean Theorem.	Objectives: Students... • know, understand, and apply the Theorem
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Measurement: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Estimate, make, and use measurements to describe and compare phenomena.	Objectives: Students... • describe and use estimates and actual measurements in real-life situations
Standard #2: Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.	Objectives: Students... • choose appropriate units of measurement and apply the concept of accuracy (significant level) at predetermined levels
Standard #3: Understand the process, structure, and use of systems of measurement.	Objectives: Students... • understand the process and relate measurement to number, data, and geometry
Standard #4: Describe the meaning of and use perimeter, area, volume, angle measure, capacity, density, weight, and mass as forms of measurement.	Objectives: Students... • identify and calculate the area of a rectangle and triangle, volume of a cube, and a box • find the perimeter of simple figures (triangle, rectangle, and polygons) • use customary and metric units for length (meter, decimeter, centimeter), mass and capacity • use powers of ten to metric measurement and scientific notation • identify, name and classify 2-dimensional geometric figures and shapes
Standard #5: Develop, describe, and use the concepts of rates and other derived and indirect measurements.	Objectives: Students... • use computations with elapsed time (e.g., hours worked from a given time to another given time, etc.) and conversions from one unit of time to another
Standard #6: Develop and apply formulas and procedures for determining measures to solve problems.	Objectives: Students... • develop and apply formulas for area (including surface area), perimeter, and volume for standard figures, objects, and for figures derived from combinations of known figures, both 2D and 3D (i.e. a figure made by combining a rectangle and circle)

Strand #4: Probability, Statistics, and Discrete Math

When students gather their own data, they become intimately familiar with the information, they develop an understanding of what it really means to organize and summarize data.

When students draw conclusions based on their experiences, they develop the skills needed to become critical consumers of someone else's data summaries and analyses. Only through personal experiences with the whole process can students develop critical thinking skills to question, analyze, and interpret data from outside sources. (NCTM Standards)

Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Collect, organize, and describe data systematically.	Objectives: Students... • collect, organize, display, and describe information and data in many forms
Standard #2: Construct, read, and interpret tables, charts, and graphs.	Objectives: Students... • simulate, display, graph, and analyze data using multiple representations such as technology, tables, charts, and graphs • construct and interpret line plots, stem and leaf plots, and frequency distributions
Standard #3: Make inferences and convincing arguments that are based on data analysis.	Objectives: Students... • analyze survey data to make predictions and to solve problems
Standard #4: Evaluate arguments that are based on data analysis.	Objectives: Students... • evaluate arguments that are based on data analysis
Standard #5: Develop and explain why statistical methods are powerful aids for decision making.	Objectives: Students... • calculate and describe mean, median, mode and range • read and interpret statistical data to make predictions, inferences, and decisions

Probability: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Model situations by devising and carrying out experiments or simulations to determine probabilities.	Objectives: Students... • carry out probability experiments; discuss the results

Probability (continued)

Standard #2: Construct a sample space to determine probabilities.	Objectives: Students... determine the probabilities of real-world situations such as weather, sports, etc.
Standard #3: Describe the power of using a probability model by comparing experimental results with mathematical expectations.	Objectives: Students... conduct experiments to determine experimental probabilities and construct a table to establish theoretical probabilities, and compare the two results
Standard #4: Make predictions that are based on experimental or theoretical probabilities, and determine their reasonableness.	Objectives: Students... solve problems using probability methods; make and analyze predictions in relation to their reasonableness
Standard #5: Develop and explain an appreciation for the pervasive use of probability in the real world.	Objectives: Students... cite at least five real-world situations and show how probability is used in each

Discrete Math:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Explore discrete mathematics concepts.	Objectives: Students... - create and use Venn diagrams to solve problems - create simple algorithms to solve problems - use counting techniques (tree diagram, permutation and combination techniques) to determine the number of outcomes for situations - investigate the benefits of simple circuits and networks (paper routes, mail delivery) - use logic and inductive reasoning to make predictions related to a series of statements
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BPS Learning Standards: Eighth Grade Mathematics

Strand #1: Number Sense

Number sense refers to an intuitive feeling for numbers and their various uses and interpretations; an appreciation for various levels of accuracy when figuring; the ability to detect arithmetical errors; and a common sense approach to using numbers. (NCTM Standards)

Number Sense and Number Relationships: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Understand, represent, and use equivalent forms of numbers (integers, fractions, decimals, percents, exponents, and scientific notation) in the real world and in problem solving situations.	Objectives: Students... • reinforce place value with respect to whole numbers and decimals • relate this to computation, metric system, exponential form and scientific notation
Standard #2: Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • master computations with fractions (decimals, percent, ratio and proportion) and real numbers (integers, rationals, irrationals) • understand the effects of operations, e.g. squaring, multiplying and dividing by numbers between 0 and 1
Standard #3: Understand and apply ratios, proportions, and percents.	Objectives: Students... • understand and apply ratio and proportion to probability and geometry to solve numerical problems
Standard #4: Investigate and describe the relationship among fractions, decimals, and percents.	Objectives: Students... • continue to investigate and describe the relationship among fractions, decimals, and percents
Standard #5: Represent numerical relationships in one- and two-dimensional graphs.	Objectives: Students... • use a graphing calculator to graph ordered pairs and convert numerical patterns from tables to graph form

Number Sense, Computation, and Estimation

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Compute with whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • master the laws of exponents (integer and rational)
Standard #2: Develop, analyze, and explain procedures for computation and techniques for estimation.	Objectives: Students... • use estimation technique and inverse operations to confirm results
Standard #3: Develop, analyze, and explain procedures for solving proportions.	Objectives: Students... • recognize and use ratio and proportion
Standard #4: Select and use an appropriate method for computing from among mental arithmetic, paper and pencil, calculator, and computer methods.	Objectives: Students... • use a variety of approaches for computing and solving problems (including the graphing calculator)
Standard #5: Use computation, estimation, and proportions to solve problems.	Objectives: Students... • use estimation to solve problems involving money, length, area, perimeter, and volume
Standard #6: Estimate to check the reasonableness of results.	Objectives: Students... • apply a variety of methods to check reasonableness of results

Number Systems and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and explain the need for numbers other than whole numbers.	Objectives: Students... • create and solve problems that require the use of numbers other than whole numbers in the context of geometry, probability, and statistics
Standard #2: Know and use order relations for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • master the types of numbers (whole and real numbers, integers, rationals and irrationals)
Standard #3: Use operations involving fractions, decimals, integers, and rational numbers.	Objectives: Students... • master operations involving fractions, decimals, integers, rational, and irrational numbers

Number Systems and Number Theory (continued)

Standard #4: Demonstrate how basic operations are related to one another.	Objectives: Students... • master equivalent representation of procedures (i.e. demonstrate and describe the relationship of addition for whole numbers, fractions, decimals) • use concrete and abstract models to understand and describe the mathematical processes underlying the operations of addition, subtraction, multiplication, and division (and their relationship with one another) on fractions, decimals, and integers
Standard #5: Create and apply number theory concepts, including prime numbers, factors, and multiples.	Objectives: Students... • master the laws of exponents (integer and rational) • master the use primes and properties of numbers such as GCM and LCM to compute and/or approximate powers and roots

Strand #2: Patterns, Relations, and Functions

One of the central themes of mathematics is the study of patterns and functions. This study requires students to recognize, describe, and generalize patterns and build mathematical models to predict the behavior of real-world phenomena that exhibit the observed pattern. (NCTM Standards)

Patterns and Functions: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, extend, analyze, and create a wide variety of patterns.	Objectives: Students... • explore number patterns; generate rules for number sequences; • use graphing calculator to express the data in tabular, symbolic and graphic form
Standard #2: Describe and represent relationships with models, tables, graphs, and rules; use sentences and algebraic expressions.	Objectives: Students... • continue to describe and represent patterns using models, tables, graphs, simple rules, and manipulatives such as Algebra Lab Gear
Standard #3: Analyze functional relationships to explain how a change in one quantity results in a change in another.	Objectives: Students... • develop and apply the idea of a function as a certain sort of relationship between quantities
Standard #4: Use patterns and functions to represent and solve problems.	Objectives: Students... • develop and apply the concept of function through the linear and quadratic levels

Algebra:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and apply the concepts of variable, expressions, and equation .

Objectives: Students...

- continue to develop and apply key concepts such as variable, equivalence, order, and inverse in the context of number, algebra, and geometry

Standard #2: Represent situations and number patterns with tables, graphs, verbal rules, and equations, and explore the interrelationships of these representations.

Objectives: Students...

- continue to use the graphing calculator to generate tables and graphs and identify algebraic relationships
- explore number patterns; generate rules for number sequences

Standard #3: Analyze tables and graphs to identify properties and relationships.

Objectives: Students...

- continue to use tables and graphs to identify and describe properties and relationships

Standard #4: Demonstrate an ability to solve linear equations using concrete, informal, and formal methods.

Objectives: Students...

- continue to use calculators, computers, concrete manipulatives (i.e. Algebra Lab Gear), and real-life situations to explore and describe linear relationships and to solve simple linear equations
- represent real-life situations to solve linear and square functions
- explore the modification to a given function which causes it to stretch, shrink, shift and/or translate

Standard #5: Describe the strategies used to explore inequalities and nonlinear equations.

Objectives: Students...

- master the attributes of linear equations and inequalities, absolute value, and quadratic equations

Standard #6: Apply algebraic methods to solve a variety of real-world and theoretical problems.

Objectives: Students...

- develop and apply algebraic ideas of patterns, relationships, and functions in all areas of mathematics

Standard #7: Construct expressions or equations that model problems.

Objectives: Students...

- construct, interpret and evaluate formulas and expressions drawn from real-life and other academic domains

Algebra (continued)

Standard #8: Explore and describe a variety of ways to solve equations: include hands-on activities, trial and error, and numerical analysis.	Objectives: Students... • use multiple strategies and tools to solve equations
Standard #9: Know and apply algebraic procedures for solving equations and inequalities.	Objectives: Students... • apply algebraic procedures for solving equations and inequalities

Strand #3: Geometry and Measurement

The study of geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretations can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Identify, describe, compare, and classify geometric figures.	Objectives: Students... • master the basic geometric figures • continue to classify polygons
Standard #2: Explore and describe the properties of points, lines, and planes.	Objectives: Students... • master selected properties
Standard #3: Visualize and represent (i.e. build, draw) geometric figures.	Objectives: Students... • master the use of sine, cosine, tangent ratios to solve right triangles
Standard #4: Explore and describe transformations of geometric figures.	Objectives: Students... • use in combination the transformation of translation, reflection, rotation and dilation • define similarity and congruence in terms of transformation
Standard #5: Represent and solve problems using geometric models.	Objectives: Students... • relate geometric shapes and ideas to the measurement, ratio and proportion
Standard #6: Understand and apply geometric properties and relationships.	Objectives: Students... • recognize and draw symmetric, similar and congruent figures and solve problems using similarity of figures

Geometry (continued)

Standard #7: Develop and explain the concept of Pi (Π).	Objectives: Students... • measure the circumference and diameter of at least five different circular objects and explain how the ratios approach Pi.
Standard #8: Develop and explain the concept of the Pythagorean Theorem.	Objectives: Students... • know, understand and apply the Pythagorean Theorem

Measurement:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Estimate, make, and use measurements to describe and compare phenomena.	Objectives: Students... • master the reading and the interpretation of scales and the degree of accuracy that is appropriate
Standard #2: Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.	Objectives: Students... • master the appropriate units of measurement and apply the concept of accuracy (significant level) at predetermined levels
Standard #3: Understand the process, structure, and use of systems of measurement.	Objectives: Students... • understand the process and relate measurement to number, data, and geometry
Standard #4: describe the meaning of and use perimeter, area, volume, angle measure, capacity, density, weight, and mass as forms of measurement.	Objectives: Students... • master the formulas for the perimeter, surface area, and/or volumes of common geometric shapes • utilize the number of dimensions in a shape to determine appropriate formulas
Standard #5: Develop, describe, and use the concepts of rates and other derived and indirect measurements.	Objectives: Students... • understand and use compound measures, including speed and density
Standard #6: Develop and apply formulas and procedures for determining measures to solve problems.	Objectives: Students... • apply formulas for the perimeter, surface area, and/or volumes of common geometric shapes

Strand #4: Probability, Statistics, and Discrete Math

An understanding of probability and the related area of statistics is essential to being an informed citizen. Students in middle grades have an intense interest in the notions of fairness and the chances of winning games. The study of probability develops concepts and methods for investigating such situations. (NCTM Standards)

Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Collect, organize, and describe data systematically.	Objectives: Students... • collect, organize, display, and describe information and data in many forms
Standard #2: Construct, read, and interpret tables, charts, and graphs.	Objectives: Students... • design and use data collection sheets; access information from reference sources; where appropriate, use graphing calculators to create frequency tables
Standard #3: Make inferences and convincing arguments that are based on data analysis.	Objectives: Students... • design a questionnaire or an experiment to capture needed to follow lines of inquiry and to test hypothesis
Standard #4: Evaluate arguments that are based on data analysis.	Objectives: Students... • evaluate arguments that are based on data analysis
Standard #5: Develop and explain why statistical methods are powerful aids for decision making.	Objectives: Students... • calculate, estimate and use appropriate measures of central tendency, i.e., mode, median, and mean with discrete data • read and interpret statistical data to make predictions, inferences, and decisions

Probability: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Model situations by devising and carrying out experiments or simulations to determine probabilities.	Objectives: Students... • carry out probability experiments; discuss the results
Standard #2: Construct a sample space to determine probabilities.	Objectives: Students... • determine probabilities of real-world situations such as weather, sports, etc.

Probability (continued)

Standard #3: Describe the power of using a probability model by comparing experimental results with mathematical expectations.	Objectives: Students... • identify the outcomes of a two experiment combinations; use tabulations and/or tree diagrams to represent the events; learn the calculation methods that involve tree diagram, permutation and combination
Standard #4: Make predictions that are based on experimental or theoretical probabilities, and determine their reasonableness.	Objectives: Students... • solve problems using probability methods; make and analyze predictions in relation to their reasonableness
Standard #5: Develop and explain an appreciation for the pervasive use of probability in the real world.	Objectives: Students... • cite at least five real-world situations and show how probability is used in each.

Discrete Math: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #2: Explore discrete mathematics concepts.	Objectives: Students... • investigate and describe the mathematical properties of sets and systems that have a countable number of elements • create and use Venn diagrams to solve problems • create simple algorithms to solve problems • use counting techniques, tree diagrams, permutations and combination techniques • investigate the benefits of simple circuits and networks (e.g., paper routes, mail delivery) • use logic and inductive reasoning to make predictions related to a series of statements

Introductory Note: High School Mathematics Sequence

The standards for high school mathematics included on the following pages are presented in two sequences (which are represented by Students #1 and #2 in the chart below). If a student elects the first sequence, s/he would complete Calculus by the close of twelfth grade. Less than 10% of students in public schools in the Commonwealth of Massachusetts complete Calculus by the end of the twelfth grade.

If a student elected the second sequence, s/he would complete our Integrated Mathematics curriculum by the close of the twelfth grade. Less than 50% of students in the Commonwealth now complete a mathematics curriculum of comparable rigor by the close of the twelfth grade.

The third student in the chart represents a student who elected the 9-12 Integrated Math sequence, but decided to accelerated his or her program after s/he'd completed Integrated Math 1A&B in the tenth grade. This student went on to complete Pre-Calculus by the time s/he graduated.

The fourth student in the chart elected the accelerated sequence, only to find that s/he needed more time to master the concepts in the curriculum. This student shifted to the 9-12 Integrated Math sequence and finished the sequence by the close of twelfth grade.

In all cases, the students (and their parents) have the opportunity to elect the sequence they'd like to tackle. In addition, at different points during their high school years, they all have opportunities to accelerated or decelerate their pace.

The standards for Pre-Calculus, Calculus, and Discrete Mathematics will not be develop until late May. All of the standards for Integrated Math are included in this document.

One final note on the document. At this point in the process, all of the standards are presented in narrative form. By the close of this summer, we expect to complement the narrative with examples of problems students will be required to solve at each grade level, and teaching vignettes that will give teachers a snap-shot of exemplary lessons and practices. In addition, we expect to convert the entire set of standards into an easy-to-read wall chart that will present the standards in a single-page kindergarten through twelfth grade format.

High School Math: Student Scenarios (examples)

	9th Grade	10th Grade	11th Grade	12th Grade
Student #1	Integrated Mathematics Course 1A&B	Integrated Mathematics Course 2A&B	Pre-Calculus	Calculus or Discrete Math
Student #2	Integrated Mathematics Course 1A	Integrated Mathematics Course 1B	Integrated Mathematics Course 2A	Integrated Mathematics Course 2B
Student #3	Integrated Mathematics Course 1A	Integrated Mathematics Course 1B	Integrated Mathematics Course 2A&B	Pre-Calculus
Student #4	Integrated Mathematics Course 1A&B	Integrated Mathematics Course 1B	Integrated Mathematics Course 2A	Integrated Mathematics Course 2B

BPS Learning Standards: Integrated Mathematics 1A&B

Strand #1: Number Sense

Number sense refers to an intuitive feeling for numbers and their various uses and interpretations; an appreciation for various levels of accuracy when figuring; the ability to detect arithmetical errors; and a common sense approach to using numbers. (NCTM Standards)

Number Sense and Number Relationships:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Compare and contrast the real number system and its various subsystems with regard to their structural characteristics.	Objectives: Students... • distinguish between rational and irrational numbers. • conduct, model, recognize, compare and order rational and irrational numbers. • appreciate that irrational numbers complete the real number system. • recognize when and how to apply the field properties in problems using real numbers.
Standard #2: Develop the complex number system and demonstrate facility with its operations.	Objectives: Students... • appreciate the need to extend the real number system to complex number system through investigation of problems. • use a coordinate system to locate complex numbers. • investigate (or appreciate) what is gained, what is lost and what is retained in moving from real-number system to the complex number system.
Standard #3: Understand the logic of algebraic procedures and their interrelationship with geometric ideas and concepts.	Objectives: Students... • use transformations to explore the concept of vectors.
Standard #4: Understand the basic concepts of real and complex numbers.	Objectives: Students... • construct, model, recognize, compare, and order real numbers. • understand/use radical, exponential, and logarithmic expressions in appropriate settings.
Standard #5: Appreciate that seemingly different mathematical systems may be essentially the same.	Objectives: Students... • investigate examples of systems used in various disciplines, e.g., designing electrical circuits (series/parallel), searching electronic databases (and/or), using binary operations ($\times$ & $+$)

Number Sense and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Use estimation strategies to judge the reasonableness of results of computation and problem solving involving real and complex numbers.

Objectives: Students...

- use logical reasoning, as well as estimation and mental computations, to determine the validity of a solution in algebraic, geometrical, and statistical problems.

Standard #2: Use estimation when making and interpreting graphs.

Objectives: Students...

- use scatter plots of sets of data points to graph best-fitting lines.

Number Sense, Computation, and Operations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop operation sense for real and complex numbers.

Objectives: Students...

- use manipulatives, diagrams, and graphs to solve computational problems with rational, irrational, and complex numbers.
- understand and demonstrate algebraically and graphically the relationship between operations and their inverses, including exponential and logarithmic.
- understand the appropriate use of graphing calculators to solve problems involving real and complex numbers.
- understand and calculate the upper and lower bounds of numerical solutions of algebraic problems, particularly in the context of measurement and statistics.
- solve problems involving absolute values.

Standard #2: Relate the mathematical language and symbolism of operations to problem situations

Objectives: Students...

- pose and solve problems using operations on whole numbers, integers, rational, irrational, and complex numbers.
- apply the process of mathematical modeling to real world problem situations.

Strand #2: Patterns, Relations, and Functions

Mathematics is an exploratory science that seeks to understand every kind of pattern that occurs in nature, patterns invented by the human mind, and even patterns created by other patterns. (*On the Shoulder of Giants*, Lynn Arthur Steen)

Relation Functions:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Describe, extend, analyze, and create a wide variety of patterns.

Objectives: Students...

- examine numeric and geometric patterns found in nature, mathematics, different cultures, and historical periods.
- use inductive reasoning to make generalizations from an observed pattern.
- use inductive and indirect methods to pose and prove theorems.
- collect and graph data (using graphing calculators and/ or computers when appropriate), and express relationships between variables, both verbally and symbolically.
- explore situations involving linear, quadratic, polynomial, trigonometric, exponential, logarithmic, and rational functions as well as piecewise defined functions and relationships that are not functions at all.
- use polynomial, rational, trigonometric, exponential, and logarithmic functions to model real world phenomena.
- understand and appreciate that a variety of phenomena can be modeled by the same type of function.
- predict and express the n th term in arithmetic, geometric, and other (e.g. Fibonacci) sequences, both explicitly and recursively.
- explore formulas for finite and infinite sums of series.

Standard #2: Represent and analyze relationships, using tables, verbal rules, equations, and graphs.

Objectives: Students...

- translate among tabular, symbolic, and graphical representations of functions.

Standard #3: Model real-world phenomena with a variety of functions.

Objectives: Students...

- recognize that a variety of problem situations can be modeled by the same type of function.

Relation Functions (continued)

Standard #4: Analyze the effects of parameter changes on the graphs of functions.	Objectives: Students... • use graphing utilities to observe and predict the behavior of many types of functions, including direct and inverse variation, general polynomial, radical, step, exponential, logarithmic, and trigonometric functions. • associate parameter changes in functions with transformations on a coordinate system. • explore the concept of inverse function informally as the process of undoing the effect of applying a given function. • explore through activities and apply the effect of reflecting the graph of a function across the line $y = x$.
Standard #5: Investigate limiting processes by examining infinite sequences and series.	Objectives: Students... • explore limiting sums for sequences of fractions and repeating decimals.

Algebra:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Represent situations that involve variable quantities with expressions, equations, inequalities, and matrices.	Objectives: Students... • model solve problems that involve varying quantities with variables, expressions, inequalities, absolute values, vectors, and matrices. • use matrices as tools for representing data in an organized fashion.
Standard #2: Use tables and graphs as tools to interpret expressions, equations, and inequalities.	Objectives: Students... • use paper and pencil techniques and graphing calculators (or other technology) to represent and analyze graph of expression, equations, and inequalities.

Algebra (continued)

Standard #3: Operate on expressions and matrices, and solve equations and inequalities.	Objectives: Students... • use manipulatives (e.g., algebra tiles) and diagrams to develop procedures for simplifying and operating on expressions (multiplying binomials and factoring trinomials). • explain, use and analyze procedures for operating on algebraic expressions and matrices. • formulate and solve real problems using algebraic expressions and matrices. • use polynomial, rational, trigonometric, exponential functions, and simultaneous linear equations to model real world relationships • solve equations and inequalities from real problems by algebraic and graphical methods. • use a variety of methods for solving equations and inequalities and develop an understanding of appropriate use.
Standard #4: Apply trigonometry to problem situations involving triangles.	Objectives: Students... • use problems from navigation and surveying, (e.g.) to extend understanding of ratios of right triangle trigonometry to angles of any size.
Standard #5: Explore periodic real-world phenomena, using the sine and cosine functions.	Objectives: Students... • develop conceptual understanding of the sine and cosine functions, using graphing calculators. • use graphing utilities to explore the use of sine and cosine functions as mathematical models for such periodic phenomena as uniform circular motion, temperature changes, sound waves, and tide variations.
Standard #6: Apply general graphing techniques to trigonometric functions.	Objectives: Students... • develop an understanding of the properties of trigonometric functions and their inverses. • graph and investigate the behavior of trigonometric functions.

Strand #3: Geometry and Measurement

The study of geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretations can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry and Spatial Sense: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Understand and apply properties involving angles, parallel lines, and perpendicular lines.	Objectives: Students... • explore transformation in terms of rotation, reflection, translations, dilations, congruence, symmetry, and isometric. • explore and use properties of parallel, perpendicular lines, bisectors of angles and segments, triangles and circles through construction.
Standard #2: Interpret and draw three dimensional objects.	Objectives: Students... • analyze properties of three dimensional shapes by constructing models and by drawing and interpreting two dimensional representations of them. • study quadratic and conic sections. • derive equation of a circle, ellipse, parabolas, and hyperbolas and their properties.
Standard #3: Represent problem situations with geometric models and apply properties of figures.	Objectives: Students... • use basic transformations to demonstrate similarity, symmetry, and congruence. • derive distance and midpoint formula in one, two, and three dimensions.
Standard #4: Use induction or deduction to solve problems and to present reasonable explanations of and justifications for the solutions.	Objectives: Students... • deduce properties of, and relationships between, figures from given assumptions. • develop and defend conclusions. • formulate counter examples.
Standard #5: Use transformations, coordinates, and vectors to solve problems.	Objectives: Students... • use basic transformations to demonstrate similarity, symmetry, and congruence of figures. • study, derive, and understand important results in coordinate geometry. • Apply vector, trigonometry, and coordinate geometry methods to the solution of problems related to lines.

Geometry and Spatial Sense (continued)

Standard #6: Interpret algebraic equations and inequalities geometrically and describe geometric objects algebraically.	Objectives: Students... • describe and use transformations in the form of matrices.
Standard #7: Extend, apply, and formalize strategies for determining perimeters, areas, volumes, and surface areas.	Objectives: Students... • use diagrams, models, and other manipulatives to determine methods of finding relationships and measurements of two and three dimensional shapes.
Standard #8: Use trigonometric ratios to solve problems involving indirect measurement.	Objectives: Students... • extend trigonometry to angles of any size, the graphs and behaviors of trigonometric functions. • apply trigonometric properties to the solution of problems in two and three dimensions, including sine and cosine rules.
Standard #9: Solve real-world and mathematical problems using geometric models.	Objectives: Students... • understand the relationship between algebraic and geometric representation of the same mathematical concept.
Standard #10: Analyze patterns produced by processes of geometric change, formally connecting iteration, approximation, limits, self-similarity, and fractional.	Objectives: Students... • use concrete models and diagrams to investigate fractals such as the Serpinski "Triangle"
Standard #11: Use manipulative, computer graphics, graphics software, and other learning tools to demonstrate geometric concepts and connections with other parts of mathematics, science and art.	Objectives: Students... • design and construct geometric patterns (e.g., tessellations) and explore connections with history and art (Islamic tiling, art of M.C. Escher).
Standard #12: Develop geometric interrelations and applications of slope.	Objectives: Students... • design investigations of physical situations involving slope. • use coordinate geometry and slopes to prove lines parallel and perpendicular.

Measurement:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Apply their knowledge of measurement in the construction of a variety of two- and three-dimensional figures.	Objectives: Students... • extend measurement, including distances and angles to more complex plane, shapes, solids. • understand and use relationships between similar figures and solids.
Standard #2: Determine the degree of accuracy of a measurement, for example by understanding and using significant digits.	Objectives: Students... • use compass and straight edge to measure geometric figures to a high degree of accuracy.
Standard #3: Develop and use the concept of indirect measurement, and use techniques of algebra, geometry and trigonometry to measure quantities indirectly.	Objectives: Students... • apply trigonometric methods to practical situations involving triangles and other figures, by using appropriate tools for measurement, developing a geometric model or diagram, and writing and solving corresponding equations.
Standard #4: Use measurement appropriately in other subject areas and career-based contexts	Objectives: Students... • use appropriate measurement tools, along with calculators and computers, to solve problems in science, technology and consumer education, and other areas as well.
Standard #5: Choose appropriate techniques and tools to measure quantities in order to achieve specified degree of precision, accuracy, and tolerance of measurements.	Objectives: Students... • use compass, straight edge manipulatives, and technology to explore geometric constructions and their applications.

Strand #4: Probability, Statistics, and Discrete Math

An understanding of probability and the related area of statistics is essential to being an informed citizen. Students in middle grades have an intense interest in the notions of fairness and the chances of winning games. The study of probability develops concepts and methods for investigating such situations. (NCTM Standards)

Statistics:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Construct, draw inferences, and reason with charts, tables, and graphs that summarize data from real-world situations.	Objectives: Students... • continue to collect, organize, and describe data
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Statistics (continued)

Standard #2: Use sampling and recognize its role in statistical claims.	Objectives: Students... • use sampling methods; consider their reliability • understand and apply the concept of random variables
Standard #3: Design a statistical experiment to study a problem, conduct the experiment, and interpret and communicate the outcomes.	Objectives: Students... • describe the normal curve and use its properties to answer questions about a set of data
Standard #4: Apply measures of central tendency, variability, and correlation.	Objectives: Students... • describe the depression of a set of data • find and interpret the central tendencies, variabilities, distribution, and correlation of sets of data
Standard #5: Transform data to aid in data interpretation and prediction.	Objectives: Students... • use curve fitting to make predictions from data • study the effects of transformation on data in predicting outcomes
Standard #6: Test hypotheses by using appropriate statistics.	Objectives: Students... • analyze the effects of data transformations on measures of central tendencies and variability

Probability: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Use simulations to estimate probabilities.	Objectives: Students... • explore different types of probability distributions
Standard #2: Use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty.	Objectives: Students... • understand when and how to estimate conditional probabilities and apply these methods to solve problems • test hypotheses by using appropriate, predetermined limits of significance
Standard #3: Apply the concept of random variable.	Objectives: Students... • generate and interpret probability distributions including binomial, uniform, normal, and chi-square

Discrete Mathematics:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Represent problem situations using discrete structures such as finite graphs, matrices, sequences, and reoccurrence relations.

Objectives: Students...

- represent data (points) and solve problem situations using graphs, trees, networks, and matrices.
- make extensive use of Venn (and other) diagrams, along with logical connectives and statements to solve problems from real situations (e.g., economics, finance, sociological.)

Standard #2: Represent and analyze finite graphs using matrices.

Objectives: Students...

- represent networks (e.g., connecting one and two-way streets) with a graph, then use matrices to investigate and interpret possible paths.

Standard #3: Develop and analyze algorithms.

Objectives: Students...

- use algebraic and geometric iteration to explore patterns and solve problems.

Standard #4: Solve numeration and finite probability problems.

Objectives: Students...

- use manipulatives, diagrams, graphs, and technology tools to create and interpret discrete probability distribution.
- use counting principles such as factorial functions, combinations and permutations to solve problems.
- create different discrete probability distributions using technologies whenever appropriate.

Standard #5: Represent and solve problems using linear programming and difference equations.

Objectives: Students...

- explore, using manipulatives and graphs, problems situations involving optimization.
- use algorithms for finding optimal paths and circuits in graphs.
- analyze different algorithms for efficiency in solving optimization problems.

Standard #6: Investigate and describe problem situations that arise in connection with computer validation and the application of algorithms

Objectives: Students...

- investigate and discuss variations which occur when using different algorithms to solve a problem

Discrete Mathematics (continued)

Standard #7: Use inductive and deductive reasoning to investigate problem situations involving networks.

Objectives: Students...

- solve network problems (e.g., finding points producing the shortest network), first experimentally, then using geometric constructions and deductive reasoning to validate their findings

BPS Learning Standards: Integrated Mathematics 2A&B

Strand #1: Number Sense

The focus of the secondary school curriculum remains-as it should-on the transition from concrete to conceptual mathematics. As students' understanding moves from number to variables, from description to proof, from special cases to general equations, they learn the power of mathematical symbols. In a very real sense, the major objective of secondary mathematics is to develop symbol sense. (*Everybody Counts*, NRC)

Number Sense, Numeration, and Mathematical Structure :

Number Sense and Number Relationships:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Compare and contrast the real number system and its various subsystems with regard to their structural characteristics.	Objectives: Students... • recognize when and how to use the field properties in problems using real numbers. • express and simplify numerical expressions involving real numbers. • express real numbers in fractional and radical form as well as in exponential, from using integral and fractional exponents.
Standard #2: Develop the complex number system and demonstrate facility with its operations.	Objectives: Students... • solve problems with complex number solutions, using graphing and algebraic techniques. • using models to analyze and understand subsystems of the complex number system. • use a coordinate system to locate complex numbers.
Standard #3: Understand the logic of algebraic procedures and their interrelationship with geometric ideas and concepts.	Objectives: Students... • use transformations to explore the concept of vectors.
Standard #4: Understand the basic concepts of real and complex numbers.	Objectives: Students... • construct, model, recognize, compare, and order real numbers • understand/use radical, exponential, and logarithmic expressions in appropriate settings.
Standard #5: Appreciate that seemingly different mathematical systems may be essentially the same.	Objectives: Students... • compare subsystems of the real and complex number systems, using a variety of models including physical transformations.

Number Sense and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Use estimation strategies to judge the reasonableness of results of computation and problem solving involving real and complex numbers.

Objectives: Students...

- use logical reasoning, as well as estimation and mental computations, to determine the validity of a solution in algebraic, geometrical, and statistical problems.

Standard #2: Use estimation when making and interpreting graphs.

Objectives: Students...

- use scatter plots of sets of data points to graph best-fitting lines.

Number Sense, Computation, and Operations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop operation sense for real and complex numbers.

Objectives: Students...

- use manipulative, diagrams, and graphs to solve computational problems with rational, irrational, and complex numbers.
- understand and demonstrate algebraically and graphically the relationship between operations and their inverses, including exponential and logarithmic.
- understand the appropriate use of graphing calculators to solve problems involving real and complex numbers.
- understand and calculate the upper and lower bounds of numerical solutions of algebraic problems, particularly in the context of measurement and statistics.
- solve problems involving absolute values.

Standard #2: Relate the mathematical language and symbolism of operations to problem situations.

Objectives: Students...

- pose and solve problems using operations on real and complex forms.
- apply the process of mathematical modeling to real world problem situations.

Strand #2: Patterns, Relations, and Functions

Mathematics is an exploratory science that seeks to understand every kind of pattern that occur in nature, patterns invented by the human mind, and even patterns created by other patterns.

(On the Shoulder of Giants, Lynn Arthur Steen)

Relation Functions: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, extend, analyze, and create a wide variety of patterns.	Objectives: Students... • examine numeric and geometric patterns found in nature, mathematics, many cultures, and historical periods. • use inductive reasoning to make generalizations from an observed pattern. • use inductive and indirect methods to pose and prove theorems. • collect and graph data (using graphing calculators and/ or computers when appropriate), and express relationship between variables, both verbally and symbolically. • explore situations involving linear, quadratic, polynomial, trigonometric, exponential, logarithmic, and rational functions as well as piece wise defined functions and relationships that are not functions at all. • use polynomial, rational, trigonometric, exponential, and logarithmic functions to model real world phenomena. • understand and appreciate that a variety of a phenomena can be modeled by the same type of function. • predict and express the nth term in arithmetic, geometric, and other (e.g. Fibonacci) sequences, both explicitly and recursively.
Standard #2: Represent and analyze relationships, using tables, verbal rules, equations, and graphs.	Objectives: Students... • translate among tabular, symbolic, and graphical representations of functions.
Standard #3: Model real-world phenomena with a variety of functions.	Objectives: Students... • recognize that a variety of problem situations can be modeled by the same type of function.

Relation Functions (continued)

Standard #4: Analyze the effects of parameter changes on the graphs of functions.	Objectives: Students... • use graphing utilities to observe and predict the behavior of many types of functions, including direct and inverse variation, general polynomial, radical, step, exponential, logarithmic, and trigonometric functions. • associate parameter changes in functions with transformations on a coordinate system. • explore the concept of inverse function informally as the process of undoing the effect of applying a given function. • explore through activities and apply the effect of reflecting the graph of a function across the line $y = x$.
Standard #5: Investigate limiting processes by examining infinite sequences and series.	Objectives: Students... • explore limiting sums for sequences of fractions and repeating decimals.

Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Represent situations that involve variable quantities with expressions, equations, inequalities, and matrices.	Objectives: Students... • model solve problems that involve varying quantities with variables, expressions, inequalities, absolute values, vectors, and matrices. • use matrices as tools for representing data in an organized fashion.
Standard #2: Use tables and graphs as tools to interpret expressions, equations, and inequalities.	Objectives: Students... • collect, organize, and analyze data from real problems, using graphing calculators and other technology to create tables and graphs. • use sequence feature of graphing calculators to list and graph recursive functions.

Algebra (continued)

Standard #3: Operate on expressions and matrices, and solve equations and inequalities.	Objectives: Students... • use manipulative (e.g., algebra tiles) and diagrams to develop procedures for simplifying and operating on expressions (multiplying binomials and factoring trinomials). • explain, use and analyze procedures for operating on algebraic expressions and matrices. • formulate and solve real problems using algebraic expressions and matrices. • use polynomial, rational, trigonometric, exponential functions, and simultaneous linear equations to model real world relationships.
Standard #4: Apply trigonometry to problem situations involving right triangles.	Objectives: Students... • use problems from navigation and surveying (e.g.) to extend their understanding of ratios of right triangle trigonometry to angles of any size
Standard #5: Explore periodic real-world phenomena, using the sine and cosine functions.	Objectives: Students... • develop conceptual understanding of the sine and cosine functions, using graphing calculators • use graphing utilities to explore the use of sine and cosine functions as mathematical models for such periodic phenomena as uniform circular motion, temperature changes, sound waves, and tide variations
Standard #6: Apply general graphing techniques to trigonometric functions.	Objectives: Students... • develop an understanding of the properties of trigonometric functions and their inverses • graph and investigate the behavior of trigonometric functions

Strand #3: Geometry and Measurement

The study of geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretations can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry and Spatial Sense: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Understand and apply properties involving angles, parallel lines, and perpendicular lines.	Objectives: Students... • explore transformation in terms of rotation, reflection, translations, dilations, congruence, symmetry, and isometric. • explore and use properties of parallel, perpendicular lines, bisectors of angles and segments, triangles and circles through construction.
Standard #2: Interpret and draw three dimensional objects.	Objectives: Students... • analyze properties of three dimensional shapes by constructing models and by drawing and interpreting two dimensional representations of them. • study quadratic and conic sections. • derive equation of a circle, ellipse, parabolas, and hyperbolas and their properties.
Standard #3: Represent problem situations with geometric models and apply properties of figures.	Objectives: Students... • use basic transformations to demonstrate similarity, symmetry, and congruence. • derive distance and midpoint formula in one, two, and three dimensions.
Standard #4: Use induction or deduction to solve problems and to present reasonable explanations of and justifications for the solutions.	Objectives: Students... • deduce properties of, and relationships between, figures from given assumptions. • develop and defend conclusions. • formulate counter examples.
Standard #5: Use transformations, coordinates, and vectors to solve problems.	Objectives: Students... • use basic transformations to demonstrate similarity, symmetry, and congruence of figures. • study, derive, and understand important results in coordinate geometry. • Apply vector, trigonometry, and coordinate geometry methods to the solution of problems related to lines.

Geometry and Spatial Sense (continued)

Standard #6: Interpret algebraic equations and inequalities geometrically and describe geometric objects algebraically.	Objectives: Students... • describe and use transformations in the form of matrices.
Standard #7: Extend, apply, and formalize strategies for determining perimeters, areas, volumes, and surface areas.	Objectives: Students... • use diagrams, models, and other manipulatives to determine methods of finding relationships and measurements of two and three dimensional shapes.
Standard #8: Use trigonometric ratios to solve problems involving indirect measurement.	Objectives: Students... • extend trigonometry to angles of any size, the graphs and behaviors of trigonometric functions. • apply trigonometric properties to the solution of problems in two and three dimensions, including sine and cosine rules.
Standard #9: Solve real-world and mathematical problems using geometric models.	Objectives: Students... • understand the relationship between algebraic and geometric representation of the same mathematical concept.
Standard #10: Analyze patterns produced by processes of geometric change, formally connecting iteration, approximation, limits, self-similarity, and fractional.	Objectives: Students... • use manipulatives, diagrams, models and computer software to investigate shapes with fractional dimensions (e.g., fractals)
Standard #11: Use manipulative, computer graphics, graphics software, and other learning tools to demonstrate geometric concepts and connections with other parts of mathematics, science and art.	Objectives: Students... • design and construct geometric patterns in two and three dimensions, and investigate connections with other parts of mathematics, science, art, and other areas
Standard #12: Develop geometric interrelations and applications of slope.	Objectives: Students... • design investigations of physical situations involving slope of linear, quadratic, and higher order functions

Measurement:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Apply their knowledge of measurement in the construction of a variety of two- and three-dimensional figures.

Objectives: Students...

- extend measurement, including distances and angles to more complex plane, shapes, solids
- understand and use relationships between similar figures and solids

Standard #2: Determine the degree of accuracy of a measurement, for example by understanding and using significant digits.

Objectives: Students...

- use compass and straight edge to measure geometric figures to a high degree of accuracy

Standard #3: Develop and use the concept of indirect measurement, and use techniques of algebra, geometry and trigonometry to measure quantities indirectly.

Objectives: Students...

- apply trigonometric methods to real problems involving indirect measurement of right and non-right triangles, circles, and other shapes. Use appropriate tools for measurement, develop a geometric model or diagram, and write and solve corresponding equations

Standard #4: Use measurement appropriately in other subject areas and career-based contexts

Objectives: Students...

- use appropriate measurement and technology tools to analyze and solve problems from science, technology, and consumer education, as well as other areas

Standard #5: Choose appropriate techniques and tools to measure quantities in order to achieve specified degree of precision, accuracy, and tolerance of measurements.

Objectives: Students...

- use compass, straight edge manipulatives and technology to explore geometric constructions and their applications

Strand #4: Probability, Statistics, and Discrete Math

An understanding of probability and the related area of statistics is essential to being an informed citizen. Students in middle grades have an intense interest in the notions of fairness and the chances of winning games. The study of probability develops concepts and methods for investigating such situations. (NCTM Standards)

Statistics:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Construct, draw inferences, and reason with charts, tables, and graphs that summarize data from real-world situations.

Objectives: Students...

- continue to collect, organize, and describe data

Statistics (continued)

Standard #2: Use sampling and recognize its role in statistical claims.	Objectives: Students... • use sampling methods; consider their reliability • understand and apply the concept of random variables
Standard #3: Design a statistical experiment to study a problem, conduct the experiment, and interpret and communicate the outcomes.	Objectives: Students... • describe the normal curve and use its properties to answer questions about a set of data
Standard #4: Apply measures of central tendency, variability, and correlation.	Objectives: Students... • describe the depression of a set of data • find and interpret the central tendencies, variabilities, distribution, and correlation of sets of data
Standard #5: Transform data to aid in data interpretation and prediction.	Objectives: Students... • use curve fitting to make predictions from data • study the effects of transformation on data in predicting outcomes
Standard #6: Test hypotheses by using appropriate statistics.	Objectives: Students... • analyze the effects of data transformations on measures of central tendencies and variability

Probability: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #5: use simulations to estimate probabilities.	Objectives: Students... • explore different types of probability distributions
Standard #5: use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty.	Objectives: Students... • understand when and how to estimate conditional probabilities and apply these methods to solve problems • test hypotheses by using appropriate, predetermined limits of significance
Standard #5: apply the concept of random variable.	Objectives: Students... • generate and interpret probability distributions including binomial, uniform, normal, and chi-square

Discrete Mathematics:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Represent problem situations using discrete structures such as finite graphs, matrices, sequences, and reoccurrence relations.

Objectives: Students...

- represent data (points) and solve problems using graphs, trees, networks, and matrices.
- make extensive use of Venn (and other) diagrams, along with logical connectives and statements to solve problems from real situations (e.g. economics, finance, sociology).

Standard #2: Represent and analyze finite graphs using matrices.

Objectives: Students...

- use finite graphs to represent networks from real problem situations, then use matrices to represent and analyze paths and other relationships

Standard #3: develop and analyze algorithms.

Objectives: Students...

- use algebraic and geometric iteration to explore patterns and solve problems.

Standard #4: Solve numeration and finite probability problems.

Objectives: Students...

- use manipulative, diagrams graphs, and technology tools to create and interpret discrete probability distribution.
- use counting principles such as factorial functions, combinations and permutations to solve problems.
- create different discrete probability distributions using technologies whenever appropriate.

Standard #5: Represent and solve problems using linear programming and difference equations.

Objectives: Students...

- explore, using manipulative and graphs, problems situations involving optimization.
- use algorithms for finding optimal paths and circuits in graphs.
- analyze different algorithms for efficiency in solving optimization problems.

Standard #6: Investigate and describe problem situations that arise in connection with computer validation and the application of algorithms.

Objectives: Students...

- analyze different algorithms for accuracy and efficiency, in solving optimization problems

Discrete Mathematics (continued)

Standard #7: Use inductive and deductive reasoning to investigate problem situations involving networks.	Objectives: Students... • solve complex network problems, first experimentally, then using deductive reasoning to validate findings
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**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**Science
Middle School**

**Version 96.1
June 28, 1996**

Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework

Science
Middle School

Version 3.0
June 18, 1996

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Science in the Boston Public Schools: Introduction

Purpose

Put simply, the purpose of science education in the Boston Public School is for students to understand both how *to do* and *to use* science so they will value and participate in the intellectual, democratic, and vocational possibilities of science in American society.

The Nature of Science

Science may be simply described as human attempts to give good accounts of the patterns we see in nature. The characteristics of a "good account" and the particular "patterns we see" are the essence of scientific debate and consequence. The output of science, in its purist form, is ideas. At their scientific best, ideas become theories and laws. Overall, it may be said that the key criterion of science is that it is a clear, rational and preferably law-like account of a pattern in nature based on publicly accessible evidence and inferences, and accompanied by a model that offers a naturalistic explanation, whether conceptual, mathematical and/or mechanical.

The Use of Science

In its purist form science is an intellectual tradition, an inheritance of a set of ideas about nature: how it works, what is not yet known, and how to learn more. Because science has been successful from time to time in the foregoing pursuits, it is possible to use this information for practical efforts which make useful products of nature. This practical effort is called technology.

Our Standards

We have identified twelve standards in Science Understandings and Skills. These standards build from those identified in the National Science Education Standards and the Massachusetts Science Curriculum Frameworks. We expect all students to achieve the following standards, by the end of high school:

Science Understandings:

Standard #1: Students understand the role of observation and experimentation in the scientific process and the development of scientific theories.

Standard #2: Students understand the "big ideas" of science: the unifying concepts of the life sciences, physical sciences, and earth and space sciences.

Standard #3: Students have a deep understanding of the key concepts, principles, phenomena, and basic factual material included in at least one of the following subjects: biology, chemistry, or physics.

Standard #4: Students understand how humans use technology and the design process to respond to the natural world and to solve everyday problems.

Standard #5: Students understand humankind's interactions with nature over time, the technologies we have developed, the benefits and consequences of our actions, and the impact of science.

Standard #6: Students connect the study of science and technology to a variety of career opportunities.

Science Skills:

Standard #1: Students ask appropriate scientific questions, recognize experimental approaches to answering such questions, and develop their own answers to many questions through personal observation and experimentation.

Standard #2: Students gather scientific information through observation and experimentation in the laboratory and in the field; through questioning and interviewing; and through library work and other information-gathering activities.

Standard #3: Students organize the results obtained by observation, experimentation, questioning, interviewing, and library work, differentiating between evidence, inference, and opinion; they check and revise their explanations against scientific knowledge, experiences, and the observations of others.

Standard #4: Students communicate the results obtained by observation, experimentation, questioning, interviewing, and library work, through models, illustrations, narratives, and oral presentations.

Standard #5: Students research, analyze, and evaluate social, environmental, and personal challenges, problems and concerns, through observation, experimentation, research, and the application of the unifying concepts of science.

Standard #6: Students utilize appropriate technologies (including calculator-based laboratories, micro-computer based laboratories, CD-ROM, laser discs, and telecommunications), to expand the own capacity to obtain, utilize, and present information effectively, and to apply science principles to the solution of design/ engineering problems.

Criteria for the Development of the Science Standards and Curriculum Frameworks:

The following criteria guided the development of the K-12 science standards and curriculum framework for the Boston Public Schools. We chose to:

- Honor the intellectual coherence and common currency of each of the scientific domains (life sciences, physical sciences, space and earth sciences), while integrating content and instruction, wherever practical, through topics that will build students' understanding of concepts from more than one domain.
- Align our efforts with the National Science Education Standards, the Massachusetts Science Curriculum Framework, and the curriculum and materials development efforts sponsored by the National Science Foundation.
- Ensure that all students are engaged in hands-on science instruction in every grade.
- Ensure that all graduates develop scientific literacy in each of the major science domains and an in-depth understanding of at least one of the following domains: Biology, Chemistry, Physics.
- Ensure that good materials are available to teachers and students, given the standards we've developed for the particular grade levels.

- Seek a proper balance between depth of understanding and breadth of content covered. If we want students to *do* and to *use* science, they must have a deep understanding of the most essential science concepts, and be able to apply this understanding in meaningful ways. We have identified the minimum core science to be taught (70% of science instruction), while leaving teachers time for elective units (30% of science instruction).

Organization and Requirements:

Students in grades K-9 will study topics that include and often integrate concepts from the Life Sciences, Physical Sciences, Earth and Space Sciences, and Technology each year. Students in grades K-2 will receive a minimum of 90 minutes of hands-on science instruction per week. Students in grades 3-5 will receive a minimum of 135 minutes of hands-on science instruction per week. Students in grades 6-9 will receive a minimum of 225 minutes of hands-on science instruction per week.

High school level courses beyond the ninth grade will remain specialized, at least until more integrated materials are readily available. These courses will include Biology, Chemistry, and Physics at every high school in the city. Each student is required to successfully complete three years of high school science, including Integrated Science in the ninth grade, and either Biology, Chemistry, or Physics.

Format Guide:

The Curriculum Frameworks for each grade are arranged according to three categories: Student Requirements, Content Objectives (Topics), and Skill Objectives. Below are brief descriptions of each category.

1. **Student Requirements:** These are tasks students must complete as a condition of course completion.
2. **Content Objectives:** Each topic is described in five sections:
 - a. **Key Questions:** These are open ended, non-judgmental, inquiry-promoting questions that invite exploration of concrete, yet wide-ranging issues and problems. They do not address generic issues, such as “patterns” or “change,” nor do they ask for answers to specific queries, such as, “What is the speed of light?” To answer these questions well students must:
 - engage in disciplined inquiry, emphasizing the use of evidence, inference, and model building.
 - deeply understand key concepts and principles.
 - reference key people, events, phenomena, discoveries, documents, etc.
 - make connections between the content, their experiences, and the world outside of school.
 - communicate their findings clearly and precisely.
 - b. **Key Concepts, Principles, Lessons, and Phenomena:** These are the concepts, and lessons students must understand. Students will be able to clearly explain them, using real-world examples, apply them to the solution of real-world problems, and reference them when answering Key Questions.
 - c. **Entry Points and Applications:** These are people, events, objects, ideas, and themes that are especially provocative, illustrative, or accessible. They serve as entry points for, or examples/applications of, the content of each topic. Students will use these to enter, illuminate, or apply their knowledge of the topic, and to answer Key Questions.
3. **Skill Objectives:**
 - a. **Skills and Processes:** These are skills students must develop to conduct scientific inquiry.
 - b. **Technologies and Instruments:** These are items students will learn to use.
4. **The Science Domains: Grade Level Content Connections**

The topics of each grade are aligned with the *Massachusetts Curriculum Frameworks Science and Technology Curriculum Content Chapter: Owning the Questions*. Each Framework Strand has been woven into the BPS Curriculum Framework. Inquiry appears in the Key and Sub-Questions of each topic. The Technology and Human Affairs Strands are woven throughout the Key Questions; the Key Concepts, Principles, Lessons, and Phenomena; the Entry Points and Applications; and the Technologies and Instruments sections of the BPS Curriculum Framework.

In the section entitled "The Science Domains: Grade Level Content Connections", the Key Concepts, Principles, Lessons, and Phenomena from the BPS Curriculum Frameworks have been arranged in the appropriate Domains of Science (Life, Physical, and Earth and Space Sciences), as defined by the Massachusetts Curriculum Frameworks, to illustrate the connections between the Massachusetts and the BPS curriculum frameworks.

Sixth Grade Science:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Develop a portfolio of at least thirty original illustrations of objects and organisms from throughout the school year.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Write book reports about famous scientists or inventors.
- * Make a presentation (to a large or small group of students and teachers) including evidence, an inference and a model used to explain a concept in one of the year’s topics.
- * Keep a notebook of their partial and complete answers to the Key Questions and Subquestions of each topic.
- Pass teacher tests of terms and concepts presented in the year’s topics.
- Complete their homework.
- Pass the Citywide Curriculum Assessment in sixth grade science. (Not a requirement for 1996-1997.)
- * Complete four “Boston Science Laboratory Reports” per science topic studied.
- Report on an interview with a practicing or applied scientist or an older BPS student who has completed a science fair project, or present their science exposition to young students and answer questions from them. (This make take the place of the presentation above.)
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip such as Whale Watch, Trailside Museum, Arnold Arboretum, or Community Project).
- * Complete a science exposition, including individual or team projects or whole-class theme-based projects with individually-differentiated tasks (see “Protocols” for Science Fair/Science Exposition).
- Report on a TV science or technology program.
- * Complete one "Why This Topic?" summary or essay per topic.

Important Note:

All students are expected to complete two of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select two of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: Human Body Systems

Key Questions: How does the body work?

Subquestions:

- What are its structure and function?
- How do the body and environment interact?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- The organization of all human systems (i.e. cell, tissue, organ, system).

Key Concepts, Principles, Lessons, and Phenomena (continued):

Students will understand...

- The main function of each system; how they are interrelated and how each interacts with the environment.

Entry Points and Applications:

- Open heart surgery
- Cholesterol
- Diabetes
- Brain surgery
- Acne
- Exercise
- Aerobics
- Asthma
- Organ transplants
- Chapter 6: Experiments and Observations on Gastric Juice and the Physiology of Digestion. Case Study by William Beaumont (M.D. 1785-1853)

Topic: Electromagnets and Motors

Key Question: What is an electromagnet?

Subquestions:

- How do electromagnets differ (from each other; from magnets)?
- How are electromagnets used in society?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Electricity and magnetism are closely related forces.
- Electromagnetic power is a function of electric current passing through a wire coil.
- Electric (electromagnetic) motors represent technical applications of electromagnetism.
- Electric motors are widely used in society.

Entry Points and Applications:

- Household appliances such as blenders, electric clocks, fans, washing machines.
- Industrial applications: electricity generation, electric pumps
- Toys: electric race cars

Topic: Food Chemistry

Key Question: What is good food?

Subquestions:

- Chemically, what is food?
- Nutritionally, what is food (energy, substance)?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Food can be described chemically, both in terms of energy content and material composition.
- Chemical composition of food in relation to the organism's metabolic needs determines its nutritional value.

Entry Points and Applications:

- RDAs and food labels
- Proteins, carbohydrates, fats, oils
- Good diet
- Junk Food
- Kwashiorkor (protein deficiency disease)
- Phenylketonuria (PKU; amino acid utilization disease)

Topic: Water

Key Questions: What does water do?

Subquestions: Where is water?

How does water move?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- The hydrologic cycle (evaporation, precipitation, condensations and run-off)
- Geography of water (where is it; how much; what qualities)
- Tides and shore-lines
- Erosion and deposition
- Ocean currents
- Salinity
- Mechanisms of water wells and water wheels
- Dams, flood control,
- Wave powered electrical generation

Entry points and applications:

- Christopher Columbus
- Ogallala aquifer
- Free Willy
- Charles River Watershed
- Colorado River and Grand Canyon
- Title V
- Chatham Beach erosion
- Mississippi Delta
- Neponset River Watershed
- Intra and international water rights
- Army Corps of Engineers
- Great Salt Lake

Skill Objectives:

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Designing and conducting a scientific investigation. Students:
 - a. Identify questions that can be answered through scientific investigations,
 - b. Use appropriate tools and techniques to gather, analyze, and interpret data,
 - c. Develop descriptions, explanations, predictions, and models using evidence,
 - d. Recognize and analyze alternative explanations and predictions,
 - e. Communicate scientific procedures and explanations, and
 - f. Use mathematics in all aspects of scientific inquiry.

(This set of skills primarily contributes to fulfilling the ability “to do science” portion of the Purpose.)

2. Evaluating social or personal issues in terms of how science can and cannot contribute to their clarification and resolution. Students:
 - a. Identify aspects of social and personal issues which can be addressed through scientific study
 - b. Prudently apply scientific knowledge to these social or personal issues.

(This skill, in addition to those in Item 1, contributes to fulfilling the ability “to use science” portion of the Purpose.)

* Adapted from the National Research Council’s *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- simple compound microscope
- ammeter
- volt meter
- electric motor
- seismograph printout

Students will be able to measure science phenomena using a CBL sensor interfaced with a graphing calculator (e.g., measuring the velocity of an object moving on a ramp, respiration rate).

The Science Domains: Sixth Grade Content Connections

Life Sciences

- Human body systems: circulatory, digestive, endocrine, immune, respiratory, skeletal, nervous; human life cycle

Physical Sciences

- Electricity
- Motors
- Magnets
- Law of magnets
- Magnetic field
- Electromagnetism
- Electric generators
- Forms of energy
- Energy transformations

Earth and Space Science

- Properties of the Earth: size, shape, land forms, ocean and continents, rocks and minerals, rock types, volcanoes, Earth's interior
- Earth processes: earthquakes, mountain building, metamorphism, rock cycle

Seventh Grade Science:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Develop a portfolio of at least thirty original illustrations of objects and organisms from throughout the school year.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Write book reports about famous scientists or inventors.
- * Make a presentation (to a large or small group of students and teachers) including evidence, an inference and a model used to explain a concept in one of the year’s topics.
- * Keep a notebook of their partial and complete answers to the Key Questions and Subquestions of each topic.
- Pass teacher tests of terms and concepts presented in the year’s topics.
- Complete their homework.
- Pass the Citywide Curriculum Assessment in seventh grade science. (Not a requirement for 1996-1997.)
- * Complete four “Boston Science Laboratory Reports” per science topic studied.
- Report on an interview with a practicing or applied scientist or an older BPS student who has completed a science fair project, or present their science exposition to young students and answer questions from them. (This may take the place of the presentation above.)
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip such as Whale Watch, Trailside Museum, Arnold Arboretum, or Community Project).
- * Complete a science exposition, including individual or team projects or whole-class theme-based projects with individually-differentiated tasks (see “Protocols” for Science Fair/Science Exposition).
- Report on a TV science or technology program.
- * Complete one "Why This Topic?" summary or essay per topic.

Important Note:

All students are expected to complete two of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select two of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: Varieties of Life on Earth

Key Question: How are organisms similar and different?

Subquestion:

- What is a good classification system for life on Earth?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Species.
- Natural and artificial classification.
- Individual variation.

Key Concepts, Principles, Lessons, and Phenomena (continued):

Students will understand...

- Organisms as different “solutions” to the common problems living things encounter.
- Life’s kingdoms: animal, fungus, monera, plant and protista.
- Attributes of organisms (extinct or extant) from selected phyla or divisions.

Entry Points and Applications:

- How many phyla can I eat? How much organismic diversity is there in American Cuisine? Japanese? • Carolus Linnaeus • Endangered species • Arnold Arboretum
- Biggest, littlest, fastest, slowest, oldest, youngest... • Boston Fish Market
- Organisms of the Cambrian explosion (see Gould, *Wonderful Life* and subsequent popular discussions) • New England Aquarium • Museum of Comparative Zoology
- New England Flower Show • A well-stocked supermarket (produce, seafood, meats)
- Brewery, winery, or bread baking (e.g. uses of fungus) • Ice-age mammals
- Seed catalogs: flower and vegetables

Topic: Earth: Rocks, Geologic Events and Disasters

Key Questions: Where does the surface of the Earth come from? Where does it go?

Subquestions:

- Of what is the surface of the Earth made?
- Why are there volcanoes?
- Where do mountains come from?
- Where do mountains go?
- How can buildings and bridges survive an earthquake?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Characteristics and classification of rocks.
- Volcanoes.
- Earthquakes.
- Seismology and the Richter scale.
- Sea floor spreading.
- Plate tectonics.
- Hot spots.
- Faults.
- Continental drift.

Entry Points and Applications:

- Boston puddingstone • Mt. Pinatubo • Mt. Saint Helens • Quarries
- Issues: “How sure must you be about predicting an earthquake before you are willing to make your knowledge public?” • Mineral Room of the Museum of Comparative Zoology
- NOVA Series on Volcanoes • San Francisco Earthquake (1993?) • Sara Bisel
- H. F. Reid • J. Tuzo Wilson

Topic: Force, Motion, and Machines

Key Questions: What is energy? What is work? What is force? What is power?

Subquestions:

- How is energy described?
- How is work described?
- How is force described?
- How is power described?
- How does motion begin, end and change?
- How is motion described?
- What is a good machine?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Energy.
- Work.
- Force.
- Power.
- Motion.
- Simple machines.
- Cases of machine use in society.

Entry Points and Applications:

- Balls and Ramps (Insights Curriculum Kit)
- Bicycle gears
- Cranes
- Raceways exhibit at The Children's Museum)
- Automobile transmissions
- Shovels with handles of varying lengths
- Human joints

Topic: Solids, Liquids, and Gases

Key Question: What characterizes solids, liquids, and gases?

Subquestions:

- What is a solid?
- What is a liquid?
- What is a gas?
- What are defining properties?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Characteristics of solids: crystalline, elastic (Hooke's Law).
- Characteristics of liquids: relative incompressibility, surface tension.
- Characteristics of gases: compressible, expandable.
- Pressure: fluid and atmospheric.
- Density.
- Buoyancy.
- Gross effects of temperature changes and the three states.

Note: The gas laws are scheduled for chemistry.

Entry Points and Applications:

- Hot air balloons
- Sinking and floating: boats and other objects
- Archimedes
- Sinking and floating: different liquids (saltwater, alcohol, tap water, sugar water)
- Solid and pneumatic bicycle tires
- Automobile suspensions and the "smooth ride"
- Building materials (wood, metal, brick, glass)

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Designing and conducting a scientific investigation. Students:
 - a. Identify questions that can be answered through scientific investigations,
 - b. Use appropriate tools and techniques to gather, analyze, and interpret data,
 - c. Develop descriptions, explanations, predictions, and models using evidence,
 - d. Recognize and analyze alternative explanations and predictions,
 - e. Communicate scientific procedures and explanations, and
 - f. Use mathematics in all aspects of scientific inquiry.

(This set of skills primarily contributes to fulfilling the ability "to do science" portion of the Purpose.)

2. Evaluating social or personal issues in terms of how science can and cannot contribute to their clarification and resolution. Students:
 - a. Identify aspects of social and personal issues which can be addressed through scientific study
 - b. Prudently apply scientific knowledge to these social or personal issues.

(This skill, in addition to those in Item 1, contributes to fulfilling the ability "to use science" portion of the Purpose.)

* Adapted from the National Research Council's *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- Microscope
- Triple beam balance
- pH meter
- Thermometer
- Computers
- CD ROM
- Laser disks
- Overhead projector
- SLR camera
- Techniques for plant and animal preservation (also museums, herbaria, zoos)

Students will be able to measure science phenomena using a CBL sensor interfaced with a graphing calculator (e.g., measuring the velocity of an object moving on a ramp, respiration rate).

The Science Domains: Seventh Grade Content Connections

Life Sciences

- Species
- Natural and artificial classification
- Classification of animals
- Attributes of organisms
- Natural selection
- Organisms and the physical environment

Physical Sciences

- Convection currents
- Characteristics of solids: crystalline, elastic (Hooke's Law)
- Characteristics of liquids: incompressibility, surface tension
- Characteristics of gases: compressibility, expandability
- Pressure: fluid and atmospheric
- Density and buoyancy
- Temperature and states of matter
- Forces and motion: distance traveled, time for trip, average speed, direction of motion
- Simple machines

Earth and Space Sciences

- Earth processes: characteristics and classification of rocks, earthquakes, seafloor spreading, faults, seismology and the Richter scale, plate tectonics, continental drift, volcanoes

Eighth Grade Science:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Develop a portfolio of at least thirty original illustrations of objects and organisms from throughout the school year.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Write book reports about famous scientists or inventors.
- * Make a presentation (to a large or small group of students and teachers) including evidence, an inference and a model used to explain a concept in one of the year’s topics.
- * Keep a notebook of their partial and complete answers to the Key Questions and Subquestions of each topic.
- Pass teacher tests of terms and concepts presented in the year’s topics.
- Complete their homework.
- Pass the Citywide Curriculum Assessment in eighth grade science. (Not a requirement for 1996-1997.)
- * Complete four “Boston Science Laboratory Reports” per science topic studied.
- Report on an interview with a practicing or applied scientist or an older BPS student who has completed a science fair project, or present their science exposition to young students and answer questions from them. (This may take the place of the presentation above.)
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip such as Whale Watch, Trailside Museum, Arnold Arboretum, or Community Project).
- * Complete a science exposition, including individual or team projects or whole-class theme-based projects with individually- tasks (see “Protocols” for Science Fair/Science Exposition).
- Report on a TV science or technology program.
- * Complete one "Why This Topic?" summary or essay per topic.

Important Note:

All students are expected to complete two of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select two of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: Cells (Single cell life, Cells in multicellular organisms)

Key Questions: What do cells do?

Subquestions:

- How are cells alike?
- How are cells different?
- Where are cells found?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Cells appear to be the fundamental unit of living things.
- Cells are bounded by semi-permeable membranes.

Key Concepts, Principles, Lessons, and Phenomena (continued):

Students will understand...

- Cell structure accords with cell function.
- Cells arise from cells.

Entry Points and Applications:

- Cancer
- Stained tissue slides (plant, animal, unicellular)
- Pond water
- Sickle and normal red blood cells
- Photomicrographs of cells
- Hospital pathology lab

Topic: Lens (Optics) (source: Hewitt: *Conceptual Physics*, Chapter 30, "Lenses")

Key Questions: What is a good lens?

Subquestions:

- What do lenses do?
- How are lenses used in American society?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Light rays bend when they pass from air to glass and back to air again.
- Image formation and related terms (principal axis, focal length, etc.).
- Determining size and location of images with ray diagrams.
- Aberrations and lens defects.
- Technological applications of lenses.

Entry Points and Applications:

- A camera
- Telescope
- Microscope
- The eye
- Eye glasses, lens grinding, contact lenses
- Observatory (see Astronomy topic)
- Optometrist
- Mirrors (see Duckworth)

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Designing and conducting a scientific investigation. Students:
 - A. Identify questions that can be answered through scientific investigations,
 - B. Use appropriate tools and techniques to gather, analyze, and interpret data,
 - C. Develop descriptions, explanations, predictions, and models using evidence,
 - D. Recognize and analyze alternative explanations and predictions,
 - E. Communicate scientific procedures and explanations, and
 - F. Use mathematics in all aspects of scientific inquiry.

(This set of skills primarily contributes to fulfilling the ability "to do science" portion of the Purpose.)

2. Evaluating social or personal issues in terms of how science can and cannot contribute to their clarification and resolution. Students:
 - A. Identify aspects of social and personal issues which can be addressed through scientific study
 - B. Prudently apply scientific knowledge to these social or personal issues.

(This skill, in addition to those in Item 1, contributes to fulfilling the ability "to use science" portion of the Purpose.)

* Adapted from the National Research Council's *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- Microscopes
- Telescopes
- Mirrors
- Lenses
- Spectrophotometer

Students will be able to measure science phenomena using a CBL sensor interfaced with a graphing calculator (e.g., measuring the velocity of an object moving on a ramp, respiration rate).

The Science Domains: Eighth Grade Content Connections

Life Sciences

- species
- natural and artificial classification
- individual variation
- life's kingdoms
- attributes of organisms from selected phyla

Physical Sciences

- refraction
- reflection
- image formation
- Hooke's Law
- incompressibility
- surface tension
- compressible
- expandable
- pressure: fluid and atmospheric
- density
- buoyancy
- effects of temperature change and the three states

Earth and Space Science

- characteristics and classification of rocks
- volcanoes
- earthquakes
- seismology
- plate tectonics
- hot spots
- faults
- continental drift
- mountain building

Protocols for Student Requirements in Science:

The purpose of the protocols is to describe minimum requirements for successful fulfillment of student responsibilities in science. In addition, the protocols supply a list of resources that might be used by the teacher, student, parents and/or guardian. In support of these student requirements, the Boston Public Schools recognizes that it must provide rubrics and exemplars that clarify the types and quality of work expected of students, grades K-12, and that promote the kinds of science teaching and learning required throughout the curriculum.

1. The Boston Science Laboratory/Activity Report

The Boston Science Laboratory/Activity Report is required of all students at all grade levels. For grades K-5, the report is called a Science Activity Report. For grades 5-12, the report is called a Science Laboratory Report. The difference in names reflects differences in mode of communication, required content, and comprehensiveness and sophistication of presentation and analysis, in relation to the expected cognitive and experiential ability of the student.

The purpose of the report is to promote clear and logical communication about scientific ideas between the person conducting the investigation and his/her audience. At the kindergarten level, the report can be as simple as a child reporting to the teacher what she/he sees, hears, or feels, and what she/he thinks about the observations. This oral report might be accompanied by a drawing or short written statement. For example, a child feels the fur on a bunny or gerbil (the observations) and states that the fur is soft and keeps the animal warm (the inference or explanation). The child draws a picture of the animal, with emphasis on the fur, or writes a sentence reflecting the observation and explanation. As children become older, more informed, and more sophisticated, the format and content of the Science report parallels this growth.

Science Activity Report Format

Grades K-2: The basic format is 1) an observation based on direct sense perception of a natural phenomenon or object and 2) a statement (oral or written) of interpretation (inference, explanation, metaphor). Natural phenomena or objects includes all things of nature (animals, clouds, plants, rocks and soil, human body, etc.) as well as manipulations of nature as seen in experiments. Statements of interpretation are any ideas that go beyond what is directly perceived by the senses. For example, an animal's fur is for keeping it warm, an animal drinks water because it is thirsty, or the sun feels hot because it is made of fire.

Grades 3-5: The format remains the same as K-2 but with the following two additions: 1) The report must be written and 2) the data of the observation must be included in the form of a drawing or illustration, or chart or graph. It will help the child to note that their report is meant to answer, at least in part, one or more of the key questions.

Reports will begin with a) a title and listing of the phenomenon or object of study, b) the specific observations that the child made, c) the data that support the observation, and d) the interpretation of what was observed. See sample Science Report.

Science Laboratory Report Format

Grades 6-8: The core of the report remains the same as the "Science Activity Report," but the student makes observations that are more elaborate and precise, and often involve instruments, while the interpretations include conceptual, mathematical or mechanical explanations. In addition, the introduction should explicitly state how the report contributes to the student's answer, at least in part, to the key questions of the lesson. See sample Laboratory Report.

Grades 9-12: There are two points for consideration at this level of development, the content of the study and the format of the report. What follows are guidelines.

First, in terms of the Boston science curriculum, student laboratory investigations should help the student address, even answer, the key questions of the units. By addressing the key questions the laboratory report becomes an integral part (in the sense of coordination and coherence) of the CONTENT as well as the PROCESS of science. Nevertheless, student interest should also play a part in determining the topic of investigations. The balance between these two must be determined by the teacher and student in reference to the content of the curriculum and the student's need to develop scientific competence and confidence.

Second, in terms of the format of the Boston Science Laboratory Report, the following represents a synthesis of several extant formats used by high school and college faculty. Other formats are equally legitimate but it seems that some effort to adopt a common form is preferable at this time in the history of science education in Boston.

Reports should include:

- a. A Title
- b. A Statement of Question or Purpose: For example, "The purpose of this scientific investigation is to determine quantitatively the relationship between the quality (color) and quantity (intensity) of visible light and the rate of growth (biomass/time) of bean seedlings."
- c. An Explanation of the Study Context: In this section the student lists the reasons why the study is undertaken. For example, the study may be an extension of a class laboratory experiment; it may be an investigation that is personally interesting; it may grow out of a question that arose from the student's reading (text, science report); or it may spring from the larger scientific research community where the student participated in a research laboratory program.
- d. Procedures and Materials: The procedures and materials section describes the investigative approach and apparatus used to conduct the investigation or experiment. Unfortunately, in the hands of many school students, this section is overrun with grocery lists of everyday items (e.g. ruler, scotch tape, test tubes) and is short on the specific and essential procedures that guarantee the success of the technique. A well written procedures and materials section is characterized by a succinct style. One good drawing or photograph, with labels, can suffice for many words.
- e. Results: Data are the evidence about which we have some confidence and from which we make our inferences. Students should learn to prize this section of the report. The effective visual display of data, quantitative or qualitative, is an essential scientific skill because the form in which data are arranged contribute greatly to revealing the patterns which illustrate the underlying regularities of nature. Charts and graphs need to be neat, precisely and succinctly labeled, and include only those data which are relevant to the study.
- f. Discussion: This section gives the student's evaluation of the results of the study; her confidence in the evidence; the inferences she made; and the models, whether conceptual, mathematical and/or mechanical, that she invented or employed to give an account of the natural phenomenon as she saw it revealed in the data. Further, it is the place where the student may suggest further questions or even speculate, with care, about next moves. This is also the place where the student address the personal and societal importance of the investigation by answering the questions "What does this mean for you and society?" and "So what?"
- g. References

2. Nature Illustrations

The purpose of illustrations is to increase the student's ability to observe nature precisely and thoroughly. These are fundamental skills for all scientists and skills that can serve in all walks of life. The notebooks of famous scientists are filled with illustrations. The *National Science Education Standards* begins each grade level section of the book with a page taken from a portfolio of school students' illustrations (see attached illustrations).

In addition, young people are exceptionally visually oriented and illustrating can build on this ability. Nature and scientific illustration, it should be noted, is a skill that improves with practice. Although some children appear to have more talent, all children get better at illustrating over time. With regard to science, this simply means that all children can become better observers of nature. Teachers profit, as well, from practicing nature illustrations.

Although it is hard to state what constitutes a good illustration, there are a few criteria that must be kept in mind. Because this is science, a key criteria is accuracy. Accuracy refers to the degree of correspondence between what is emphasized in the drawing and what the phenomenon looks like. For example, for very little children, accuracy might be the ability to choose the right color crayon to fill in a scientific illustration of their banana. Given little children, the banana may be round, long and thin, or even pear shaped. The lack of shape accuracy is not emphasized because it is developmentally inappropriate.

By third grade, however, bananas need to be both yellow (as long as they aren't the green type of bananas) and shaped like a banana. But it may be inappropriate for the child to be asked to color the subtle shades of green, yellow, cream, brown, tan and black that characterize most ripe bananas.

By eighth or ninth grade, if color is the natural feature under inspection, students should be able to execute a rich, holistic, coloring of the banana. A similar developmental scheme can be established for other features of nature such as shapes, orientation, position and numbers of organisms and their parts, and the scale of organisms one to another and to features of their environs.

Furthermore, all efforts to illustrate should teach the student to seek and emphasize the distinguishing feature(s) of the natural object or phenomenon. Examples include a tiger's vertical stripes, the red of a cardinal, the leglessness of a snake, the huge eyes of a dragonfly, or the fact that a fish's tail is vertical whereas a whale's tail is horizontal, or an insect has six legs while a spider has eight and a centipede has many.

3. Photographs of Student Action

Most kids love to show pictures of themselves. This responsibility builds on that enjoyment by asking groups of students to create a photo album of themselves and their classmates engaged in doing science. Photos should include students working with scientific apparatus, participating in field studies, or presenting their scientific studies to other students or family. Photos may also include pictures of students meeting with scientists and engineers (see Protocol for Interviewing, below). These photos can become part of a class portfolio in science. See attached photos for examples.

In addition to the personal collection, photographs build community (it is difficult to take a candid picture of yourself) and lend an air of fun to science classrooms.

A number of teachers at several grade levels in the Boston Public Schools already ask students to take pictures of themselves and their classmates. They report that the students enjoy and profit from the work and that it contributes to an enjoyable and supportive classroom environment.

4. Interview with a Practicing or Applied Scientist; Interviewing an Older BPS Science Student

Interviewing A Practicing Or Applied Scientist:

Students at all levels should see and talk with practicing scientists and people who work in scientific fields. Scientists, engineers, zoo keepers, meteorologists, pet store owners, horticulturists, and farmers, among others, make their living by dealing directly with natural objects and phenomenon. They have interesting stories to tell and can extend school science far beyond the classroom walls.

For the youngest children, an interview may simply be a group interview that takes place in the classroom when a scientist or veterinarian comes to visit. By middle school level, this group interview may suffice, but it is preferable that students work in pairs or small teams to meet an engineer or farmer. In these middle school interviews, whether whole class or small group, students should try to determine what the person does, how science is used in their work, what they think science is all about, and what training or education is needed for their work. This information should be compiled and discussed by the teacher and the class.

High school students should try to travel to the site of the interviewee's work, so they are meeting the person in the context of his or her life's efforts. It is noted, however, that practical circumstances may limit high school students to conducting their interviews as a whole class and in the school building. High school students will be asked to "write-up" the results of the interviews and to send a thank-you note to the interviewee.

At any grade level, photographs of students conducting interviews can contribute to the fulfillment of the photograph responsibility.

Interviewing Older BPS Students:

A second kind of interview includes young students meeting with older BPS students in a formal discussion about particular science activities and projects. Specifically, middle or high school students who have completed high quality science fair projects are invited to present their work to younger students and to respond to questions about their projects (and to science inquiry in general).

5. Summarize an Original Science Report

This requirement exists only at the high school level. Its purpose is to engage the student with original scientific reports or parts of reports, such as especially rich graphs or illustrations. In one form, this report asks the student to identify the evidence, the inferences, and the model which are used by the scientists. In another form, the student is asked to paraphrase or summarize (a very hard exercise, even with the paper's abstract in hand) the content of the scientific paper. For students who may be severely challenged by the level of writing in original scientific papers, other writing may be substituted. For example, there are many popular accounts of nature (Lewis Thomas, Stephen Gould, science sections in newspapers, or even their classmates Science Laboratory Reports), several of which are accessible, even to readers who are below grade level.

6. Documentation of the Extracurricular Science Activity

Students complete a one-page form that asks them to list the activity (date, time, place, or a picture for younger children), briefly describe the activity, and suggest how it contributes to answering one or more of the key questions in their science curricula.

A parent/guardian signs the report and also writes a sentence in which they state what they think their child learned from the activity.

Possible sources of extracurricular science include: Museum of Science, New England Aquarium, Computer Museum, Arnold Arboretum, Boston Park Service Activities, Whale Watch, Trailside Museum, Blue Hills Reservation, Museum of Comparative Zoology, Franklin Park Zoo, Harvard College Observatory.

7. Report on a Book about Scientists or Inventors

In an effort to enrich the student's understanding of the lives of scientists, the historical and social contexts of science, and the nature of science itself, BPS students at all levels are to read or listen to, talk and/or write about books about scientists and inventors.

For grades K-2, the approach to books about scientists is the same as the approach to any other children's literature. Children should be read to; read if they are able; talk; and write, if that is appropriate. Story circles are recommended.

For grade 3-12, children and youth should read books about scientists and inventors. They should discuss these books in small groups and whole class settings. They should be asked to write about what they read. Techniques for engaging students with books about science are more or less the same as those for other forms of literature, bearing in mind that certain literary forms, such as expository prose, are more germane to the purpose of science than, say, epic poetry, because, perhaps, imagination and purpose in science are not the same as imagination and purpose in art.

8. Science Fair/Science Exposition

The purpose of the Science Fair/Exposition Project is similar to that of the Science Activity/Laboratory Report--to promote clear and logical communication about scientific ideas between the person conducting the investigation and his/her audience. However, the Science Fair/Exposition Project goes beyond written reports to include physical demonstrations and verbal support. Projects can be natural extensions of topics covered in class or can focus on other interests of the students, such as an investigation that is personally interesting, a question that arose from the student's reading (text, science report), or the larger scientific research community where the student participated in a research laboratory program.

Grades 3-5: At this level, students' projects (individual, team, or class projects) should explore questions based on their observations of the natural world. Students should gather evidence to answer their questions and may want to use a model to describe and/or analyze the phenomenon they are studying. Projects should be evaluated, but not competitively.

Grades 6-8: Students at this level must complete individual projects (team or whole-class theme-based projects are acceptable if each student has an individually-differentiated task) and should participate in an exhibition with some degree of competition. Students must pose a question or define a problem, propose a likely answer or solution, design and conduct a test or experiment (following humane and safety guidelines) or analytically describe the outcome in the case of non-experimental inquiries, and use the compiled data to evaluate the accuracy of the proposed answer, noting its strengths and weaknesses.

Throughout the project, students should keep a notebook of their progress and find at least three references to support their work. Presentations must incorporate visual aides, including charts or tables of data, and an verbal defense of the methods and results.

Grades 9-10: Students must enter individual projects in an exhibition with a competitive phase. Students must define a problem, articulate a hypothesis, design and conduct a procedure with a control and variable to test the hypothesis (following humane and safety guidelines), and use the compiled data to evaluate the accuracy of the hypothesis and its strengths and weaknesses.

Throughout the project students must record their procedures in a notebook. Students must write a report including at least three references to support their work. Presentations must include visual aides, including charts, tables or graphs, and an verbal defense of the report.

Grades 11-12: The basic format remains the same as the Grades 9-10 project. In addition, experiments should involve multiple variables. The report must include a rationale for the sample size and experimental procedures, an application of statistics (averages, ranges, etc.) to

the data, graphs, at least three references (including one from a recent journal), and a revision of the hypothesis or model based on the results of the study. Students should also evaluate competing explanations for their phenomena. Presentations must include visual aides and an oral defense using a theoretical model to explain the results.

District and building guidelines should be consulted for further details.

9. Why This Topic?: Summary or Essay

Students and teachers should know why they are studying what they are studying. To ensure this exploration of the curriculum, students and teachers must examine the reasons why each science topic and related activities are included in the curriculum. Specifically, by the end of the instruction of the topic, each student will address, at developmentally-appropriate levels, the reasons why the topic is studied. Such reasons may include, but are not necessarily limited to, the role of science in society, in the curriculum, and in the lives of students, teachers and others. In addition, the address should directly examine the key questions of each topic.

The “reasons why” will vary by subject, teacher and class, and the address will undoubtedly recur throughout the course of instruction. Teachers are encouraged to promote and allow, without punitive evaluation, “hard questions” about the curriculum, even to the point where the student can present a very strong case for some other form of school science. The point is to emphasize “giving reasons with evidence and probable consequences.” This form of thinking is essential for good science.

Grades K-5: Learners in these grade levels can express their understandings through oral and written statements. These may be limited to one or a few reasons.

Grades 6-8: Learners in these grade levels should organize their understandings in the form of a list of reasons, including evidence and possible outcomes.

Grades 9-12: Learners in these grade levels should prepare their address in the form of an essay, perhaps of 1-2 pages length in ninth and tenth grade and 3-5 pages length in eleventh and twelfth grades. (See the writing standards in the English Language Arts curriculum.)

A Checklist of Inquiry Questions for Teachers of Science*:

The following questions should be frequently heard (from both teachers and students) during science lessons. Some questions may need to be translated to a level that is appropriate for learners of different developmental abilities and knowledge. Rather than teachers directly answering the questions, students' observations should lead them to the answers to the questions.

Description

- What is it?
- What does it do, or what is its function?
- Is it typical?
- Is it real or an artifact? (Is the phenomenon really there or is it created through the experimenter's manipulation?)
- What is its significance/importance/advantage?

Investigation

- Can it be investigated scientifically?
- How can I find out about it?
- How does it work/happen?
- How does/did it begin?
- What causes it to happen? (Is there a cause/effect relationship, or just a correlation?)
- What affects it, and what does it affect? (How does it fit into the whole picture?)

Prediction

- What are the expected results?
- What would happen if _____?
- Has it changed or does it change through time?
- What are its future risks, benefits, or consequences?
- Does it always happen like this?
- Can knowledge about it be used to solve problems or be applied to other situations?

Evidence and Inference

- What is the evidence?
- Are the data/facts about it accurate?
- What inferences can I make from the evidence?
- On what assumptions is the evidence/inference based? Are the assumptions tenable?

Explanation

- What concepts, formulas and/or mechanisms apply to the phenomenon?
- What model can be built or adopted to explain the phenomenon?
- How do I support my position about it?
- What other questions do I need to ask about it?

* BSCS. *Developing Biological Literacy*. (1993). Dubuque, IA: Kendall/Hunt Publishing.

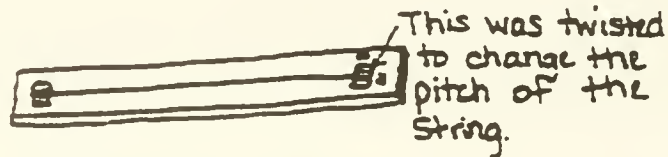
The Boston Science Laboratory Report

Grade 3-5, Example

Title: Tight String and Squeaky Sounds

Observations: I tied a string tightly between two pegs. Then I pulled the string and it made a sound. When I tightened the string by twisting one of the pegs, the pitch was higher.

Data:



The pitch was higher after the peg was twisted.

Interpretation: I think that the tighter the string the higher the pitch is and maybe, the looser the string the lower the pitch is until the string is so loose it doesn't make any sound at all. If I were to do this experiment again, I think I would try it with longer and shorter strings.

The Boston Science Laboratory Report

Grade 6-8, Example

Title: Bending Different Materials: Hooke's Law

Introduction: The purpose of my study is to show that there is a formula for the bending of solid material and how much weight it holds.

Materials: Wood, metal and plastic rulers
Weights from 5 grams to 25 grams
Supports
Ruler for measuring bending

Observations: I suspended each of the rulers, one at a time, between the supports. I measured the distance between the ruler and the top of the table.

Then I attached each weight to the middle of the ruler. I measured the distance from the ruler to the top of the table. I recorded these distances in a chart (below). I noticed that for each ruler, the heavier the weight, the more the ruler bent. The wood ruler bent the least, the plastic ruler bent the next, and the metal ruler bent the most of all.

Data:

Plastic Ruler

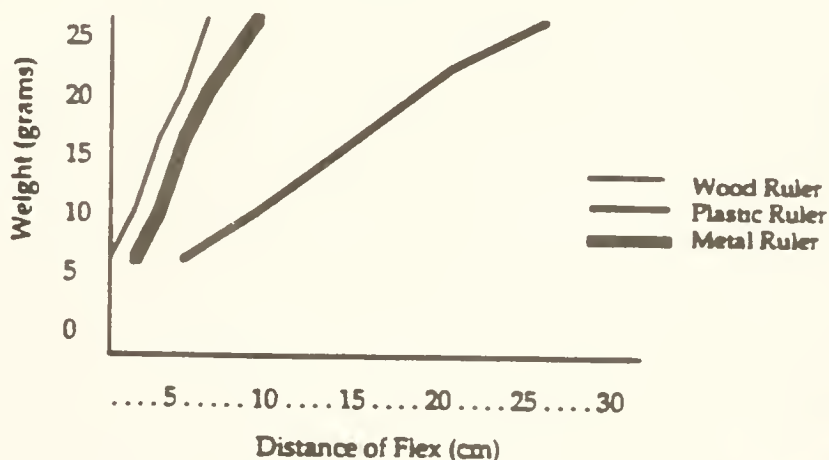
Weight	Unflexed Distance	Flexed Distance
5 g	40.0 cm	38.0 cm
10 g	40.0 cm	36.2 cm
15 g	40.0 cm	33.9 cm
20 g	40.0 cm	31.8 cm
25 g	40.0 cm	30.0 cm

Metal Ruler

Weight	Unflexed Distance	Flexed Distance
5 g	40.0 cm	34.8 cm
10 g	40.0 cm	30.3 cm
15 g	40.0 cm	24.9 cm
20 g	40.0 cm	20.0 cm
25 g	40.0 cm	14.7 cm

Wood Ruler

Weight	Unflexed Distance	Flexed Distance
5 g	40.0 cm	38.7 cm
10 g	40.0 cm	37.5 cm
15 g	40.0 cm	36.4 cm
20 g	40.0 cm	34.9 cm
25 g	40.0 cm	33.8 cm



**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**Social Studies
Sixth-Eighth Grade**

**Version 96.1
June 28, 1996**

Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework

Social Studies
Sixth-Eighth Grade

Version 96.1
June 18, 1996

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Social Studies in the Boston Public Schools:

Introduction: Core Concept and Goals

The Boston Public Schools support the core concept of the Massachusetts Social Studies Curriculum Framework:

Social Studies education teaches students to become active, responsible participants in their communities, committed to the fundamental values and principles of democracy.

In addition, we are committed to the goals embedded in the six strands included in the state framework. Students will graduate with a strong foundation in each of the following areas:

- **History**: Students will develop a sense of chronology; they will consider people, actions, and events with a critical eye, and an understanding of historical perspective.
- **Geography**: Students will develop a geographical understanding of the world, and the relationships between the physical environment, natural resources, and the human experience.
- **Civics**: Students will gain insight into what power is and how it is legitimized through governance; they will understand the principles of democracy and other systems of governance, and their roles and responsibilities as members of a democratic society.
- **Economics**: Students will explore the important role economics plays in shaping our society; they will understand basic economic theory, the principles of capitalism and other economic systems, and the practical applications of economics in our lives as citizens, workers, and consumers.
- **Cultural Studies**: Students will learn to respect and value a diversity of cultures and to recognize the rich diversity of human experience and expression.
- **World Studies**: Students will learn that as members of the global community, it is important to know and care about what happens in other places.

Finally, we turned to the National Standards for History for guidance, and identified a set of principles of particular importance. We believe that,

- children can, from the earliest elementary grades, begin to build historical understandings and perspectives and to think historically
- history needs to be linked to related studies in geography, civics, economics, social life, religion, science and technology, literature, and the arts
- our standards need to be intellectually demanding, and promote active questioning and learning rather than passive absorption of facts, dates, and names
- our standards need to strike a balance between emphasizing broad themes and probing specific events, ideas, movements, persons, and documents

Current Conditions: Standards and Curriculum Development

The Massachusetts Social Studies Curriculum Framework will not be completed until September, 1996. Consequently, our course sequence, and the grade-level standards detailing content expectations, will not be developed until the 1996-97 school year. The standards in this document focus on the *skills* students will be expected to develop and apply to any content they may study.

In addition, this document includes those products students will be expected to complete, as a condition of grade level and course completion. Each product addresses a set of geography, history, writing, and thinking skills that are relevant to any Social Studies course.

Over the course of this summer, task descriptions will be developed, describing each student product in detail. Teachers, students, and parents may use these task descriptions as instructional tools, and as tools to help them discuss and assess students' work, as it's being developed, and when it's completed. Support will be provided to help teachers become more familiar with the products and task descriptions, to share promising instructional practices, and to help them use the task descriptions most effectively.

We also hope to collect samples of students' work on these products, from schools, on a voluntary basis, at the close of the 1996-97 school year. During the summer of 1997, this student work would be reviewed and discussed by teams of teachers citywide. This process would be designed to:

- refine the performance standards for these products....define precisely what performing at or above standard really means
- identify exemplars of student work "at standard", to be made available to teachers for additional school-based professional development activities
- refine the task descriptions used to develop and assess students' work

A Five Year Plan:

The standards we have set represent expectations we will increasingly meet over the course of next five years. By the close of this decade, students will be required to achieve these standards, as a condition of graduation.

Every school and teacher needs to begin to implement these standards, and the student products, next year. Individual schools should construct careful plans that highlight the steps they will take to reach these standards within five years, and to assess student progress on an annual basis.

Boston Public Schools: Citywide Learning Standards -DRAFT- Social Studies, Middle and High School Grades

Introduction:

The skills and understandings identified below are important to the study of history, geography and social studies in all secondary grades. They are developed to increasing degrees of sophistication throughout middle school and high school.

Every middle and high school History/Social Studies teacher should develop these skills and understandings in students. Grade level differentiation comes:

- when students apply these skills to works of increasing length and complexity,
- when students are asked to make increasingly complex and sophisticated observations, insights and assertions, and
- when students' writings and other responses are evaluated for increasing levels of proficiency and increasingly complex ideas.

Strand #1: Geography

Standard: Students understand the concepts and details of physical and political geography, and humankind's political, social, and economic relationship with the physical environment.

Students will understand...

- How to use maps and other geographical representations, tools and technology to acquire, process, and report information from a spatial perspective.
- How to use mental maps to organize information about people, places, and environments in a spatial context.
- How to use maps, photos, and personal observations to analyze the spatial organization of the world's people, places, and environments.
- The key physical and human characteristics of places around the world.
- The relationship between a region's physical and human characteristics.
- How culture, experience, and stereotype influence one's perception of places and regions.
- The characteristics, distribution, and migration of human populations.
- The characteristics, distribution, and complexity of the world's cultural groups.
- Patterns and networks of economic interdependence throughout the world.
- Patterns of human settlement, growth, and decline.
- How cooperation and conflict influence the control of land and water (and vice-versa).
- How human actions modify the environment.
- How the environment affects human systems (e.g. housing, industry).
- Changes that occur in the use, distribution, and importance of resources.
- The fundamental role geography has played in shaping historical events.
- How to use geography to interpret the present and plan for the future.

Strand #2: Chronological Thinking

Standard: Students think chronologically.

Students will.....

- Place information in a chronological sequence.
- Interpret data presented on timelines and create the same to appropriate scale.
- Reconstruct patterns of historical succession and duration, and apply them to explain historical continuity and change.

Strand #3: Comprehension

Standard: Students comprehend a variety of historical and social studies source documents and materials.

Students will:

- Identify the author or source of a document or narrative and assess its credibility.
- Reconstruct the literal meaning of a passage.
- Identify the central question in an historical or contemporary narrative.
- Differentiate between facts, interpretations, opinions, and beliefs.
- Recognize the historical context of narratives and documents.

Strand #4: Analysis and Interpretation

Standard: Students engage in historical analysis and interpretation.

Students will:

- Compare and contrast differing sets of ideas, values, personalities, behaviors, and institutions.
- Consider multiple perspectives and recognize historical and contemporary interpretations as subjective.
- Incorporate multiple causes in analyses and explanations responding to historical or contemporary questions.
- Challenge arguments of inevitability.
- Make connections between the past and the present.
- Formulate probing questions.
- Consider contextual knowledge and perspectives of the time and place, and construct a sound interpretation/thesis.
- Interpret data presented on charts and graphs, and create the same to appropriate scale.

Strand #5: Research Capabilities

Standard: Students conduct historical and social studies research.

Students will:

- Effectively identify and employ a variety of reference materials, including primary source documents and information technologies.
- Formulate appropriate research questions.

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework
Grades 9-12**

**Version 96.1
June 28, 1996**

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The Boston Public Schools' Learning Standards and Curriculum Frameworks: **Goals and Guiding Principles**

Goals: The Boston Public Schools endorse the broad goals set forth in the Massachusetts Common Core of Learning. Our learning standards and curriculum frameworks are designed to produce classrooms where students are encouraged to:

- Think, Question, and Communicate
- Gain and Apply Knowledge
- Work and Contribute in Meaningful, Purposeful Ways

Students think, question, and communicate to make sense or meaning of their world and experiences. "Thinking includes being able to internalize new ideas and connect them to familiar concepts and prior knowledge." Questioning includes the framing of thoughtful questions, and the pursuit of these questions until the student fully understands. "Communicating means putting learning into the language of speech or writing, and requires reflection in such forms as examination, clarification, analysis, and synthesis."

Students gain and apply knowledge to pursue ideas and experiences, and apply this new knowledge in real life contexts. "This pursuit is interactive by nature. The more experiential it is, the more powerful the learning."

Students' work needs to be "meaningful and purposeful. The process and products of student work (need to be) valued contributions to the school and community. Imbedded in powerful learning experiences are notions of persistence, self-discipline, hard work and effort, and pride in producing quality work." (quotations from The Massachusetts Curriculum Framework, p. 6)

These goals frame the teaching, learning, and assessment process. They are critical to lifelong learning, and essential to gaining students' commitment to the learning process.

Guiding Principles: The following principles are intended to unite the members of the Boston Public Schools community. They extend our goals and provide guidelines for the continuous improvement of teaching and learning in our schools.

The Teaching/Learning Process in the Boston Public Schools:

- Engages all students in challenging, purposeful, and sustained work.
- Focuses on those skills and understandings of fundamental importance to students' success in and outside of school.
- Includes a variety of materials and strategies designed to bring out the best in every child.
- Emphasizes inquiry, problem-solving, discovery, and the real-world application of key concepts, principles, and lessons.
- Immerses students in the work, ideas, beliefs, experiences, and perspectives of people from a broad array of cultures and backgrounds.
- Is developmentally-appropriate.
- Points to the connections within and across disciplines.
- Uses assessment as an ongoing process to improve teaching and learning.
- Utilizes technology to the fullest, to enrich the learning process.
- Is nurtured by learning environments that are safe, disciplined, and focused on teaching and learning.

The Citywide Learning Standards and Curriculum Frameworks: Introduction

The Boston Public Schools Citywide Learning Standards describe what every student in the Boston Public Schools will know and be able to do, as a condition of promotion, course completion, and graduation.

The Curriculum Frameworks identify key products, tasks, and tests students will complete, and key questions they will answer, to demonstrate they have developed the knowledge and skills included in the Learning Standards.

In the Fall of 1995, the Boston Public School Committee and Superintendent Thomas Payzant responded to the emergence of new national and state-level standards, and the absence of clear expectations for Boston Public School students, by calling for the development of citywide learning standards, and curriculum frameworks, for the following core subjects:

- English Language Arts, Mathematics, Science, and Social Studies (to be developed during the 1995-96 academic year)
- World Languages (including English as a Second Language and Native Languages of our target bilingual populations), Health, Physical Education, and the Arts (to be developed in 1996-97)

Over the course of the past six months, the enclosed standards and frameworks have been developed for English Language Arts, Mathematics, Science, and Social Studies. The standards identify what students will know and be able to do as a condition of promotion, course completion, and graduation. The frameworks identify additional objectives; key products, tasks, and tests students will complete; and key questions they will answer, to demonstrate they have developed the knowledge and skills included in the standards.

The standards and frameworks are closely aligned with the Massachusetts Curriculum Frameworks and existing national standards. They have been developed by teachers and administrators from the Boston Public Schools, in collaboration with content area experts from local colleges and universities, parents, students and other members of the Boston Public Schools community.

Why do we need new standards and frameworks?

The Commonwealth of Massachusetts has developed new curriculum frameworks, including standards that define the state's expectations of students throughout the Commonwealth. By the close of this decade, students will be expected to achieve these standards as a condition of graduation from high school.

As of 1995, the Boston Public Schools did not have similar, clearly-defined expectations of our students. The schools were guided by curriculum objectives developed in the early 1980s that needed to be updated and aligned with the new state frameworks. As administrations and priorities changed over the previous decade, as the content base expanded in each subject area, and as technology allowed us to reach further than we may have ever hoped to grasp, our curriculum objectives became more dated. Though many of them are included in the state frameworks, many others were in need of revision.

What do the standards and frameworks include?

The Boston Public Schools Citywide Learning Standards and Curriculum Frameworks include two sections that present the system's expectations of students to increasing degrees of specificity. The first of these sections, the Boston Public Schools' Vision Statements for Elementary, Middle, and High School Graduates, include:

- Academic Skills and Understandings: brief, summative statements, written for important skill and content areas, summarizing key standards for fifth, eighth, and twelfth grade students
- Habits of Mind and Work: key attributes essential for success in any endeavor, at any age, in or outside of school. These habits are closely aligned with the habits promoted in the Massachusetts Curriculum Frameworks. Every teacher shares the responsibility to promote, nurture, and assess students' development of these habits.
- The Graduation Portfolio: brief descriptions of selected products students will be expected to complete, by the end of the fifth, eighth, and twelfth grades, to demonstrate their achievement of grade level standards
- Course and Test Requirements: completion requirements for all students in elementary, middle, and high school, in English Language Arts, Mathematics, Science, and Social Studies

The second of these two sections present the system's expectations of students in much greater detail. This section includes:

- Learning Standards: a description of what students must know and be able to do, in English Language Arts, Mathematics, Science, and Social Studies, at each grade level, and
- Curriculum Frameworks: important elements that provide additional structure to the curriculum, and additional direction to teachers and students alike, including:
 - *Content and Skill Objectives*: more detailed descriptions of each learning standard
 - *Key Questions*: challenging, open-ended questions students will be expected to investigate and answer well, as a condition of promotion and course completion
 - *Student Requirements*: the products, tasks, and tests students will be required to successfully complete, as a condition of promotion and course completion
 - *Task Descriptions*: detailed descriptions of each element included in the required products, explaining in precise terms what is expected of students

Note: The task descriptions are currently under development. They will be finished this summer and piloted during the 1996-97 school year.

Why these standards and frameworks?

Our standards and frameworks have been developed to align with the Massachusetts Curriculum Frameworks and nationally recognized standards in English Language Arts, Mathematics, Science, and Social Studies. We have identified standards that are appropriate for the different grade levels, and that outline expectations comparable to those in high performing districts throughout the Commonwealth. We have considered the expectations of the world of work, including the competencies outlined in the SCANS Report for America 2000, commissioned by the Department of Labor. We have used the College Board's "Academic Preparation for College: What Students Need to Know and Be Able to Do", as a point of departure in considering the expectations of colleges and universities around the country. We have conducted focus groups, including parents, students, teachers, university faculty, and other members of the community, to consider and respond to our draft standards and frameworks, in light of their expectations of students.

We have also considered the materials that are, or will be, available to teachers throughout the grade levels, when considering the content we expect students to master. Though standards and frameworks should not be developed with a particular set of materials in mind, we paid close attention to the exemplary materials that have, and are being developed, particularly in mathematics and science, as we developed our grade-level content standards and frameworks.

In addition, we developed standards and frameworks for each of the content areas that require students to learn how to learn; to ask and answer probing questions; to read analytically; to

write with clarity and precision; to observe, interpret, and appreciate the world around them; to understand and be considerate of others; to look for point of view, as well as bias and prejudice; and to develop deep understandings rather than the superficial recognition of facts.

These are the standards and curriculum frameworks that guide our teachers, other staff, and external partners in identifying, designing, and implementing curriculum, materials, and teaching and learning strategies for all of our students. The standards and curriculum frameworks chart a course to prepare our students for the world of work in the twenty-first century, and for college should they choose to attend.

Who are these standards for?

The standards we have developed are for *all* students. All students will be expected to master the same content, at or above prescribed levels of proficiency. Students with limited English proficiency or with special educational needs will be able to demonstrate achievement of these standards in ways that are different from those employed by regular education students.

Students with limited English proficiency, who have not completed their transition to regular education classes, may study content and complete assessments in their first language. These students will not be required to demonstrate proficiency in English at a level comparable to regular education students. They *will* be required to demonstrate proficiency in their native language, at similar levels of proficiency.

In addition, students who are enrolled in the transitional bilingual education program will be required to demonstrate English language proficiency at the level prescribed in the Boston Public Schools' English as a Second Language standard (to be developed in 1996-97).

For students with identified special educational needs, their individual educational plans will state the learning standards as curriculum goals, along with accommodations, levels of expectations, and performance modifications for how they will meet the standards. There is one set of standards, but how students will demonstrate achievement must be determined on an individual basis that takes into consideration individual learning needs.

A Sense of Balance: Depth and Breadth

We have attempted to balance the often-competing goals of depth and breadth in constructing our standards and curriculum frameworks. On the one hand, we expect students to have the opportunity to pursue topics and ideas until they truly understand them, and to master the processes involved in reaching deep understanding. On the other hand, we have also tried to ensure students have a breadth of knowledge that will allow them to compete with other graduates outside of school, and to pursue meaningful careers and post-secondary studies.

A Work in Progress:

The learning standards and curriculum frameworks were produced through the efforts of hundreds of teachers, administrators, parents, students, university partners, and other community members who participated on subject area teams, task groups, and focus groups. Parent groups and interested individuals also received the documents and gave recommendations. The involvement of parents and other individuals, particularly during the decision-making process on which recommendations to include, was an important component in the development of the standards. Though we are confident we have established rigorous, high-quality standards, and have provided a thoughtful framework to help teachers translate these standards into curriculum, we recognize that many questions remain, that we need to answer during the implementation process. For example:

- Have we struck the proper balance between depth and breadth?
- Do these standards include all that our students must know and be able to do?
Do they include too much?
- Do these standards and frameworks set the proper course to prepare students for the statewide assessments they must pass as a condition of graduation?
- Are the standards and frameworks really helpful to teachers?

- Do we provide enough flexibility to allow students and teachers to pursue valuable, individual interests?
- Can all of this work be completed in the time that is available to us? If yes, how?

Over the course of the next few years, as part of an annual spring review process, we expect to answer these questions (and more), and to make adjustments to improve the standards and frameworks. Just as the process we employed to develop these standards and frameworks engaged hundreds of teachers, parents, students, administrators, and community members, so too will this continuous improvement process.

First Steps: Building the Curriculum

These learning standards and curriculum frameworks set our expectations. They must be brought to life by the creative work of individual teachers. Beginning next year, teachers will begin to expand the standards and frameworks into full curricula, including teacher-developed unit guides and lesson plans, and teacher-selected materials and instructional strategies they feel will best meet our students' needs. As they do so, they will test the value and utility of the standards and frameworks in the only place they really counts: the classroom. Their findings will greatly influence any changes we may choose to make.

Simultaneously, to support the transition from identification of standards and frameworks to actual change in classroom practices, schools and central office will provide professional development opportunities for teachers and staff on curriculum development and instructional assessment practices. Parents will work with the schools and central office to develop and implement a "home" curriculum.

An Open Invitation:

We have embarked upon a course, and a challenge, for which there are few signposts. Our success will depend upon the sustained commitment of everyone engaged in the education of our children, and we want you to be involved. Please send any comments or recommendations you might have to Teaching and Learning Support Services, Boston Public Schools, 26 Court St., 6th Floor, Boston, MA 02108.

The Boston Public Schools' Vision of the High School Graduate

The following skills and understandings are essential to lifelong learning, productive work, responsible citizenship, and thoughtful participation in our diverse communities. They represent standards we expect every high school student to achieve. Every teacher, administrator, and other adult involved in the lives of our students, bilingual, special education, and regular education students alike, shares in the responsibility to ensure that all students achieve these standards.

Academic Skills and Understandings:

- **Reading and Literature:** Students read and understand challenging literature and other materials written at a level of difficulty similar to Shakespeare's Hamlet and Time magazine; they apply their understandings to real-life situations and challenges.
- **Writing:** Students write with clarity and precision, in various forms, for a variety of audiences and purposes; they employ the writing process consistently and effectively; they have mastered the conventional elements and formats for a variety of written products, including essays, business letters, resumes, and research papers.
- **Speaking, Listening, and Presenting:** Students deliver effective oral presentations, for a variety of purposes and audiences; they ask and respond to probing questions, listen carefully to others' ideas and perspectives, infer a speaker's unstated points, assumptions, or purposes, and look for gaps in reasoning or presentation; they engage in thoughtful discussions and debates with their peers and adults, including members of various cultures and socio-economic groups.
- **Mathematics:** Students apply sophisticated concepts from Algebra, Geometry, Probability, Statistics, and Discrete Math, and employ graphing calculators and a variety of strategies, to complete real-world tasks and the solve real-world problems.
- **Science:** Students use their understandings of scientific procedures and applicable concepts from the physical and life sciences to inform their thinking about complicated social, environmental, and personal concerns, and to participate in discussions and debates about them; they develop deep understandings of the concepts and procedures particular to biology, chemistry, and/or physics; they collect evidence, make inferences, and construct models to explain important concepts.
- **Social Studies/History/Geography:** Students understand the relationship between a region's physical and human characteristics, and how cooperation and conflict influence the control and utilization of natural and human resources; they apply historical understandings to analyze and respond to contemporary issues, conflicts, and concerns; they analyze these issues, conflicts, and concerns from multiple perspectives; they compare and contrast the principles of capitalism with those of other economic systems; they understand the fragile nature of our democratic principles.
- **World Languages:** Students construct short narratives; express and support opinions through role-play; ask for and give clarification; read and discuss simple stories, poems, and plays.
- **Health:** Students apply concepts of health promotion, disease prevention, and risk assessment to the practice of health-enhancing behaviors.
- **The Arts:** Students employ the arts to communicate their beliefs, experiences, ideas, and imagination.

- **Career Preparation:** Students explore a variety of careers, make connections to the academic and social/behavioral requirements of school, and plan for higher education and/or a career.
- **Research and Study Skills:** Students take notes, organize their work, do their homework, and use the library and other resources outside of school to acquire information.
- **Technology:** Students use technology to gather information, solve problems, complete and present their work, and increase their capacity to tackle increasingly complex tasks.

The Habits of Mind and Work: The following habits are also essential to students' success in high school. They are the shared responsibility of every teacher, administrator, and other adult involved in the lives of our children.

- **Curiosity and Critical Thinking:** Students listen attentively, observe carefully, and ask thoughtful questions, look for good evidence, and identify gaps in reasoning.
- **Respect for Diversity:** Students recognize and value racial, ethnic, cultural, age, gender, and individual commonalities and differences; they respect other people's perspectives.
- **Consideration and Compassion:** Students treat themselves and others with care and respect; they build trusting relationships; they help, care for, and share with one another.
- **Collaboration:** Students work well with others, give and accept constructive criticism, try to be fair, and reasonable solutions; solve problems in a peaceful manner.
- **Self-Direction:** Students check their own work, invite the critical response of others, and make appropriate adjustments.
- **Perseverance:** Students work hard until the job is done right, and are patient when the answers do not come quickly.
- **Initiative:** Students try new things, take reasonable risks, and reflect on their successes and mistakes.
- **Courage:** Students stand up for their rights and the rights of others in a positive manner that shows self-respect and respect for others; they resist harmful pressures.
- **Responsibility:** Students set goals and demonstrate responsibility for their future and the future of their families, school, communities, and environment.

The Graduation Portfolio:

Students will complete a portfolio of their work, demonstrating their acquisition of important skills, understandings, and habits. The products in the portfolio will include the following:

1. **Position Paper:** a six-page paper presenting, analyzing, and taking a position on an issue of historical and contemporary significance, built from a research question identified by the student.
2. **Biographical Paper:** a six page paper that analyzes, compares, contrasts, and reaches conclusions about the leadership styles and decision-making characteristics of two important historical figures.
3. **Science Project:** a scientific investigation in which the student poses a problem; formulates a hypothesis; designs a controlled, multi-variable experiment; and utilizes data to draw, defend, and amend conclusions that address the hypothesis.
4. **Science Presentation:** a thorough, in-depth explanation of a complex phenomenon, using appropriate real-world examples, as well as language and visuals their peers can understand and the science community can respect.
5. **In-Depth Literature Study/Peer Review/Oral Defense:** an exploration of one particular work of literature in-depth, its author, and the analysis of that work by at least one literary critic. Students produce and present a paper of no fewer than ten pages that builds from a research question they have selected. Each student also teams with two other students to read their respective papers, and to present, discuss, and defend their positions and interpretations. Each partner will comment on the others' papers, using a scoring rubric to guide their assessments. They will also prepare three challenging discussion questions, to be presented to the writer (and teacher) when the team discusses one another's papers.
6. **Math Projects:** two projects that require students to apply sophisticated concepts in the standards, to the completion of real-world tasks and the solution of real-world problems; students will employ graphing calculators to complete the tasks and solve the problems.
7. **Physical Challenge:** a certificate of completion of a physical challenge activity.
8. **Collaborative Project:** a collaborative project in which the student applies his or her learnings to educate or influence the opinions and actions of others, or to serve the community in some capacity.
9. **Career Exploration:** a project through which the student thoroughly explores a particular career and work-place, the educational (and other) requirements, day-to-day expectations and conditions, salary prospects, market needs, and its overall pros and cons, through research, shadowing experiences, and an internship, paid work experience, and/or mentoring experience.
10. **Personal Profile:** a personal profile including
 - a post-secondary education and employment plan,
 - a resume, and
 - three letters of reference attesting to the student's good character, work habits, and habits of mind (from three significant adults).
11. **Work of Art:** an original work, independent or in support of one of the products above.

Each of these products will be assessed using performance standards and rubrics that are familiar to students. The portfolios will be available to students and parents on an ongoing basis, and will serve as the foundation for regular teacher-student-parent conferences. Graduation portfolios will be fully implemented within the next five years. Portfolio entries in World Languages will be developed during 1996-97.

Course and Test Requirements:

English Language Arts: All students will be enrolled in the English Language Arts curriculum during each year in high school. Each student is required to successfully complete all course requirements each year. Students enrolled in Transitional Bilingual Education programs will meet these requirements in accordance with the English-as-a-Second Language (ESL) standards (to be developed during 1996-97)¹.

Mathematics: All students will be enrolled in the mathematics curriculum during each year in high school. Each student is required to successfully complete all course requirements each year.

Science: Students will be enrolled in the high school science curriculum for a minimum of three years. Each student is required to successfully complete the course requirements for 9th grade Integrated Science, and the course requirements for Biology, Chemistry, or Physics.

Social Studies: All students will successfully complete the high school Social Studies course sequence.

Standardized Tests: As a condition of graduation, all students will be required to pass a performance-based assessment (like the National Assessment of Educational Progress), at a proficiency level of 2 or above, and the Massachusetts tenth grade statewide assessment in English Language Arts, Mathematics, Science and Technology, and History and Social Studies.

Habits of Mind and Work: Each student will earn a satisfactory assessment for the habits of mind and work.

1. The State Department of Education is currently developing the assessment protocols for English Language Learners in accordance with the education reform legislation and MGL Chapter 71A.

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**English Language Arts
High School School**

**Version 96.1
June 28, 1996**

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English Language Arts: Introduction

The English Language Arts curriculum builds from three beliefs:

- all students need to become independent readers, fluent writers, articulate speakers, skilled listeners, discriminating viewers, and critical thinkers;
- all students need to experience and appreciate the beauty and power of language, to increase their capacity to imagine, to think, to employ language, and to understand; and
- a strong literature program is essential to the development of shared values, social skills, and social responsibility.

The following are key elements of the English Language Arts curriculum:

- *An Integrated Approach:* Skills development is combined with literature and language-rich activities. Students write and talk about what they read and watch; learn writing conventions by editing their own work and the work of others; improve their own writing by studying and modeling effective authors' use of language and conventions; read, write, present, and discuss on a daily basis.
- *An Emphasis on Whole Works of Literature:* Students read, discuss, analyze, and come to appreciate the power of whole books, on a regular basis.
- *A Common Core of Literature Representing Diverse Cultures:* Students read, discuss, understand, and appreciate a common set of great works of literature:
 - that explore problems and lessons from a variety of perspectives, eras, and places;
 - that engage students in a very personal manner;
 - that model the beauty and power of language; and
 - that help students to increase their understanding of the human experience.
- *A Focus on Inquiry:* Students explore and struggle with fundamental questions about the human experience and the structure of language and literature, and learn to construct their own meaning, and to generate their own answers, while considering the answers of others.
- *An Emphasis on Character Education:* The teaching of shared values, social skills, and social responsibility is an integral part of all literature and language arts activities. Students are encouraged to understand the perspective of others, to explore various ways to resolve conflicts, and to embrace a set of values that are shared by members of our community.
- *Meaningful Applications/Required Products/Portfolios:* Students are required to complete a variety of products that integrate their skills and understandings, are meaningful to them, and are valued in the world outside of school. These products are collected in portfolios available for review by the student, teacher, parents, and others.
- *An Emphasis on Process:* Students learn important reading, writing, organizing, presentation, and thinking strategies applicable to any task in or outside of school.
- *Daily Opportunities to Read, Write, Present, and Discuss:* Students engage in informal writing activities (e.g., journal and notebook entries, personal reflections, and summaries) on an ongoing basis; they have daily opportunities to speak, listen thoughtfully, present, and discuss; they have weekly opportunities to complete formal writing assignments (e.g., picture books, stories, letters, poems, reports, essays, research papers).

An English Language Arts curriculum including these elements produces students who:

- are lifelong readers who love reading and pursue it independently,
- enjoy writing and write with facility and clarity,
- are articulate, confident, and convincing when presenting to others,
- take pride in their work and confidently share it with others.

This approach to English Language Arts is not new. It builds on the work of Boston teachers who have successfully implemented this approach for a number of years. Our standards and curriculum framework have been developed in collaboration with many of these teachers.

English Language Arts: Principles

Reading/Literature:

- Reading is an active, constructive, and creative process that involves distinctive cognitive strategies before, during, and after reading. Good readers access prior knowledge, establish purpose, preview text, generate questions, make predictions, confirm and revise predictions, locate and clarify concepts that cause confusion, take mental or written notes, organize information into categories, and use text features such as illustrations and headings to acquire meaning from print.
- The central focus of primary grade instruction must be reading, and every element of the instructional program in the early grades must be organized to ensure success in reading for every student. From kindergarten through the second grade math, science, social studies, and other activities, should have a language arts base.
- Reading instruction should be flexible and based on individual needs. Some students come to school already reading. Some students experience initial difficulty and will need short-term intervention. Students with continuing reading difficulties will need a long-term, structured program.
- Ongoing assessment is an essential element of instruction. In kindergarten, first, and second grades, the focus of assessment should be on individual diagnosis rather than standardized achievement tests scores. Every kindergarten student needs to develop and be screened for emergent literacy skills with a quick and informal instrument. First graders need to be evaluated using a more systematic process of determining early reading progress. Students in need of additional help should be identified no later than mid-first grade and appropriate support strategies must be available.
- Powerful reading instruction connects literature (fiction and non-fiction), language, comprehension and skill instruction. Skills should not be taught in isolation.
- Phonics is one strategy in a comprehensive approach to reading instruction. Children get a better start in reading if they are taught phonics. Learning phonics helps them to understand the relationship between letters and sounds and to "break the code" that links the words they hear with the words they see in print. Because phonics is a reading strategy, it is best taught in the context of reading, not as a separate subject to be mastered. For the vast majority of students, phonics instruction should be concluded by the end of the third grade.
- Reading comprehension uses literature and language activities that should include many opportunities to read, write, and use oral language.
- A variety of whole class, small group, and individualized instruction is necessary to meet the diverse needs of students. Grouping should be flexible and based on students' interests and developmental needs. Grouping by developmental level for some skills instruction is useful as long as the grouping remains flexible with students reassigned as their needs and the tasks change.
- A strong literature program is essential to individual development and the development of community. Literature provides students with the opportunity:
 - to explore the fundamental questions of humanity;
 - to experience the lives of people from different cultures, eras, places, and economic conditions;
 - to understand their own experiences, feelings, perceptions, and concerns;
 - to recognize the universality of human emotion and experience;
 - to recognize and be sensitive to stereotypes based on race, religion, ethnicity, income, handicap, and gender;
 - to appreciate the beauty and power of language;
 - to appreciate the differences and utility of various genres;
 - to increase their capacity to imagine, to think, to employ language, and to understand.
- There is a core of traditional and contemporary literature that all children should study, understand, and value. This literature must represent and respect our diverse voices, experiences, beliefs and perspectives.

Writing:

- Good writing reflects and stimulates good thinking.
- Writing is a process including opportunities to plan (prewriting); to put initial ideas on paper in some organized context (drafting); to read aloud and reflect on the product, often in collaboration with others (editing); to revise and make corrections (rewriting); and to share the final product with others (publishing).
- The best way to fully develop writing as both an art and a skill is in a context where reading, writing, listening, speaking, viewing, and presenting all reinforce each other and none are taught in isolation.
- Students become competent learners by actively synthesizing, making connections for themselves, speaking their own thoughts and finally crafting those thoughts in writing in a way that is powerful and meaningful for them.
- Writing contributes strongly to reading comprehension; reading aloud contributes strongly to the quality of one's writing.
- Successful writers understand the structure and use of language and employ language creatively and effectively. Grammar and usage must be explicitly taught, from kindergarten through twelfth grade, as part of the writing and reading process. Grammar and usage improve most when students are:
 - regularly exposed to good models of writing, and speaking,
 - asked to study and analyze the grammatical structure and usage in the model,
 - required to write, edit, and rewrite their own work, and the work of others, until the grammar and usage meets the established standard.
- Writing assignments should emphasize writing for real purposes - including letters, notes, editorials, journals - in addition to academic assignments.
- Writing reinforces the idea that language has meaning and it allows students to take ownership of a work's language and structure.
- Spelling development for early readers should take place within the context of reading and writing activities, but other vehicles are also necessary including teaching groups of words that demonstrate sound and spelling patterns.
- Temporary spelling is useful in the primary grades to foster literacy and creativity, not to replace standard spelling.
- Vocabulary development is essential from K-12 to allow students to make specific and effective word choices (diction).

Speaking, Listening, and Presenting:

- Expressing oneself orally is essential to learning.
- Listening is an active, constructive, and creative process that involves distinctive cognitive strategies before, during, and after listening. Good listeners access prior knowledge, establish purpose, make predictions, confirm and revise predictions, generate questions, take mental or written notes, paraphrase content, check for understanding, identify and clarify concepts that cause confusion, and build from the presenter's ideas.
- Students need to learn the different speaking and listening strategies associated with communicating in everyday interpersonal situations; acquiring, interpreting, applying, and transmitting information; evaluating and generating information and ideas according to personal or objective criteria; and communicating for appreciation and entertainment.
- Students will make critical and cultural connections between oral language and written text and structures. This will be reinforced through the study of literature from a variety of cultures.
- Students' language needs to be valued. Students should be encouraged to talk; to listen carefully to one another; to take notes, paraphrase, and summarize what they've heard; and to express their ideas, opinions, and responses.

- Oral language development is important to early literacy. Teachers should engage children in oral language activities by reading to them and through meaningful discussions. Students should be encouraged to read aloud to one another and to discuss what they have read.
- Students need practice, practice, and more practice developing their oral language skills, with a particular emphasis on good diction (pronunciation and elocution).
- Students need practice, practice, and more practice developing their listening skills, with a particular emphasis on understanding what others have said and meant, in the interest of learning from and building on their ideas.

Viewing:

- Viewing "literacy" is an essential competency to be developed by all students.
- Viewing plays, television, video, film, other productions and works of art, as well as natural phenomena is an active and critical process that involves distinctive cognitive strategies before, during, and after viewing. Good viewers access prior knowledge, establish purpose, make predictions, confirm and revise predictions, generate questions, take mental or written notes, paraphrase content, check for understanding, and identify and clarify ideas or concepts that cause confusion.
- Students need to make informed judgments about plays, television, film, and other productions and works of art.

Research & Study Skills: Effective learners....

- Know how to gather and analyze information.
- Make optimal use of all available resources, and most particularly, the library.
- Organize information into categories and outlines.
- Record directions; clarify the task by asking good questions; set goals and timelines; and organize time, materials, and resources to reach these goals in an efficient and effective manner.
- Employ effective strategies to preview text and other materials.
- Employ a variety of study skills including writing-to-learn-strategies (e.g. learning logs, response journals, note taking).

Social Skills:

- A primary goal of education is to promote the development of students' social skills and values.
- One important way students learn to express themselves, and become aware of other people's points of view, is by developing strong perspective-taking skills.
- The development of students' conflict-resolution skills builds on their perspective-taking ability; it enables them to resolve conflicts and promote their own autonomy, while respecting the dignity of those they are in conflict with.
- These two social skills enable students to form healthy relationships in which both persons care for one another and help each other be self-determining.
- The careful development of social skills and values leads to healthy relationships and the improvement of students' literacy skills. The development of students' perspective-taking skills directly influences their ability to speak, listen, read, and write.
- The development of students' social and literacy skills contributes to the prevention of violent behavior on their part, and diminishes their use of alcohol and other drugs.

English Language Arts: Standards and Skill Objectives

The skills identified on the following sheets are important to all secondary school students. Students should develop these skills, to increasing degrees of sophistication, from grade level to grade level.

Every English teacher teaches these skills. Grade level differentiation comes:

- when students apply these skills to works of literature of increasing length and complexity,
- when these works of literature include increasingly sophisticated language,
- when students are asked to make increasingly complex and sophisticated observations, insights and assertions, and
- when students' writings are evaluated for increasing levels of proficiency and increasingly complex structure, language, and ideas.

In most cases the skills on the following chart remain similar across the grade levels. However, we do ask teachers to focus more intensely on developing *particular* skills at different grade levels. These skills constitute our *focus correction areas* for the different grades.

Examples of required and recommended books for each grade level (our "Core Literature": see enclosed) are also included in the skill objectives on the accompanying sheets. These books represent the increasing degree of sophistication and complexity we expect students to manage from grade level to grade level.

Our Focus on Whole Works of Literature

A minimum of four complete books should be taught in every English class each year. These four books should come from the Core Literature list by school year 1998-99 (or earlier, if funds can be identified to purchase these books for each school).

The Core Literature lists include a single required reading for each grade level, and a list of additional recommended readings, differentiated by grade-level to ensure that students are not reading the same books year after year.

Teaching Guides for each of the required readings will be completed this summer. Content Objectives for each book on the Core Literature list will also be completed this summer.

In the Spring of 1997, we expect to assess students' understanding of next year's required reading. Students' ability to perform the tasks included in these skill objectives will greatly influence their level of achievement on that assessment.

English Language Arts: Skill Objectives, 6th-12th Grade

- STRAND #1 - READING AND COMPREHENSION STRATEGIES

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #1: Students read and understand challenging materials.

- Students read and understand a variety of grade level materials, including fiction and non-fiction, books, reports, essays, and periodicals. Recommended grade-level works of literature include:

6th Grade: *Roll of Thunder, Hear My Cry*; *So Far from the Bamboo Grove*; *Bridge to Terabithia*; *Going Home*; *Julie of the Wolves*

7th Grade: *Homecoming*, *Outsiders*; *Dragonwings*; *Young Landlords*; *Pacific Crossing*

8th Grade: *Harriet Tubman*; *Dickey's Song*; *Road to Memphis*; *Journey of the Sparrows*; *Dragon's Gate*

9th Grade: *Raisin in the Sun*; *Narrative of the Life of Frederick Douglass*; *Romeo and Juliet*; *Animal Farm*; *Miracle Worker*

10th Grade: *Black Boy*; *Night*; *To Kill a Mockingbird*; *Farewell to Manzanar*; *House on Mango Street*; *Amigone*

11th Grade: *I Know Why the Caged Bird Sings*; *The Crucible*; *The Piano Lesson*; *The Joy Luck Club*; *An Island Like You*

12th Grade: *Autobiography of Malcolm X*; *Hamlet*; *Song of Solomon*; *Woman Warrior*; *Ceremony*; *The House of the Spirits*

Standard #2: Students analyze, interpret, and evaluate literature (fiction & non-fiction). They...

- Paraphrase and summarize and regular intervals
- Identify the author's purpose (to inform, persuade, inspire, entertain)
- Make evaluative analyses of their readings; define and use criteria for judgment
- Analyze readings in terms of causality; make comparisons and contrasts; relate parts to the whole; relate specific examples to general principles
- Infer an author's unstated points
- Identify an author's point of view, bias, and/or prejudice
- Support assertions (about readings) with evidence
- Predict outcomes or logical conclusions, using evidence from the readings
- Confirm or revise predictions on the basis of further reading
- Draw logical conclusions supported by evidence from the content
- Distinguish fact from opinion, assumption, interpretation, or belief
- Formulate probing questions about what they are reading
- Critique a passage, identifying examples of inaccuracy, lack of clarity, and irrelevant, inappropriate, or misleading information
- Compare, contrast, and evaluate different accounts of the same event, or differing views of the same issue
- Make critical distinctions between materials that are clear or unclear, complete or incomplete, accurate or inaccurate, logical or illogical
- Infer traits, feelings, motives, and perspectives of characters, based on what they do and say, and the author's commentary

- STRAND #1 - READING AND COMPREHENSION STRATEGIES (continued)

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #2: Students analyze, interpret, and evaluate literature (continued). They...

- Make evaluative judgments about the actions of characters
- Explain how characters or ideas are developed over the course of a reading
- Infer causal relationships in a plot
- Interpret figurative language

Standard #3: Students understand literary structures. They...

- Know, understand, and use the proper terms associated with the literary genres, including novel, short story, myth, fable, biography, autobiography, diary, editorial, essay, speech, narrative poem, comedy, and tragedy*
 - Know, understand, and use the proper terms associated with the elements of a work of fiction, including character (protagonist and antagonist), theme, problem, action, goal, setting, tone (the author's attitude toward a subject), mood (the atmosphere of a passage or work), rising action, climax, falling action, resolution (denouement), and outcome
 - Give examples of each of the elements of fiction, drawn from specific readings
 - Know, understand, and use the proper terms associated with literary conventions and techniques, including simile, analogy, metaphor, alliteration, personification, hyperbole, paradox, puns, flashback, foreshadowing, imagery, symbolism, and satire
 - Identify uses of particular literary conventions and techniques in specific readings
 - Distinguish between main plot and subplots
 - Distinguish between related supporting ideas or details and unrelated ideas or details
 - Identify propaganda
 - Make critical comparisons between literacy structures of different cultures and analyze where and how they influence American (and other) literature.
- * The genres emphasized in particular grade levels may vary by school, depending, in part, on the literature series individual schools have purchased. By the close of the eighth grade, students should meet this standard for all genres.

Standard #4: Students make connections between what they read, their own experiences, and the experiences of others. They...

- Use their prior knowledge and experience to increase their understanding
- Use the features of a book, such as the cover or illustrations, to help construct understanding
- Construct graphic organizers
- Explain the social and historical context of a passage
- Compare their own experiences to those of characters
- Compare the ideas, characters, events, and contexts in their readings to actual or current ideas, people, and events

-STRAND #2- WRITING:

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #1: Students understand the structure of written language and employ this structure effectively.

In their narratives, essays, reports, poems, and all other writings, students...

- Use standard spellings
 - Punctuate sentences properly, including commas, colons, semicolons, apostrophes, quotation marks, periods, exclamation points, and question marks
 - Capitalize correctly
 - Use appropriate abbreviations and contractions
 - Maintain subject-verb agreement and tense coherence
 - Compose complete sentences, simple and compound
 - Compose declarative, interrogative, imperative, and exclamatory sentences
 - Write fully developed paragraphs and multi-page papers, organized in a logical order
 - Use transitional phrases effectively
 - Master the specific *focus correction areas* for their grade level.
 - Understand and employ proper terms when discussing other people's writings, as well as one another's work, including:
 - parts of speech
 - verb tenses and voices (present, past, future, past participle, conditional)
 - the functional elements of a sentence (subject, predicate, dependent and independent clauses)
 - the formal language structure of stories, poems, books, essays...
 - In their discussions about works they read or listen to, students will be able to identify parts of speech and parts of sentences
- Note: Grammar should be taught, when needed, for the purpose of improving students' writing, when errors are consistently in evidence. Grammar should not be a separate, isolated topic in the secondary English Language Arts curriculum.

Standard #2: Students understand the writing process and employ the process effectively.

In the process of completing any writing assignment, students...

- Use the five-step (or similar) process of *prewriting, drafting, revising, editing, and "publishing"*
- Discuss one another's work and engage in peer editing

- STRAND #2 - WRITING (continued)

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #3: Students' writing is focused, coherent, and well-organized.

In each of their writings, students...

- Clearly present the purpose and topic of their writing (non-fiction)
- Write purposeful fiction, poetry, other "creative" works
- Use a tone that is appropriate for the intended audience
- Provide an appropriate amount of information (obtained from a variety of sources and points of view, where appropriate)
- Provide an analysis of that information (in essays, research papers, and other critical work.)
- Organize events and thoughts in a logical order
- Maintain focus and purpose
- Make choices about language to create the desired effect
- Include a conclusion that brings the work to summation

Standard #4: Students employ a variety of writing formats and utilize technology to complete and enhance their work. They...

- Use conventional formats for written products (e.g. left and right hand margins, adequate spacing between words and lines, paragraph indentation, sufficient "white space")
- Use conventional formatting for friendly and business letters, including envelopes
- Use conventional formatting for research papers, including citations and bibliography
- Word process, desktop publish, and incorporate multi-media, as appropriate, in published reports

- STRAND #3 - VOCABULARY

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard: Students understand the structure of words and demonstrate a strong vocabulary. They...

- Use structural/context clues to determine meanings
- Use a dictionary to find meanings of unfamiliar words, and record their findings
- Use a thesaurus to vary and expand on their own use of language
- Identify synonyms, antonyms, and homonyms for familiar and unfamiliar words
- Use prefixes, suffixes, and root words to determine meaning

• STRAND #4 - ORAL LANGUAGE, LISTENING, AND SPEAKING

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #1: Students engage in effective discussions. They...

- Speak with appropriate loudness, clarity, speed, and phrasing
- Ask and answer concise, clear questions, using full sentences
- Respect the turn-taking rights of others during discussions

Standard #2: Students make effective presentations. They...

- Establish a clear purpose
- Make their points logically and concisely
- Present events or thoughts in a logical sequence
- Provide necessary background information
- Use appropriate language, maintain eye contact, and use visual supports
- Respond appropriately to audience reactions and questions; provide explanations and answer questions
- Recite grade-level material aloud, with fluency and proper emphasis

Standard #3: Students understand, analyze, evaluate, and respond effectively to oral presentations. They:

- Listen to teacher and student presentations. In their notes, students will:
 - identify the speaker's purpose
 - identify key ideas and supporting details
 - identify any gaps in reasoning or presentation
 - distinguish fact from opinion, interpretation, assumption, or belief
 - identify the speaker's bias and point of view
 - infer a speaker's unstated points, assumptions, or purposes
 - draw their own conclusions
 - identify important questions that emerge from the presentation
 - In discussions and debates, students will:
 - ask and discuss key questions
 - exchange ideas and opinions with assurance and consideration
 - probe for clarity, accuracy, and understanding
 - use language and behaviors that are polite and respectful
 - give and accept constructive criticism
- Students will also be able to:
- summarize and paraphrase the previous speakers' key points

STRAND #4 - ORAL LANGUAGE, LISTENING, AND SPEAKING

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard #4: Students facilitate group discussions. They...

- Introduce the subject being taught. *(11th/12th Grades)*
- Ensure all members of the group participate in an orderly manner. *(11th/12th Grades)*
- Ensure participants' turn-taking rights are respected. *(11th/12th Grades)*
- Ensure all members have an opportunity to participate. *(11th/12th Grades)*
- Summarize and re-focus the group at key points in the discussion, and when necessary. *(11th/12th Grades)*
- Bring the discussion to closure and ensure the key points have been identified. *(11th/12th Grades)*

STRAND #5 - RESEARCH, STUDY SKILLS, AND TECHNOLOGY

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard: Students employ effective research and study skills. They...

- Follow and give directions
- Request information in writing, by telephone, and in person
- Vary their reading speed and method in relation to purpose (e.g. skimming and scanning methods)
- Write clear, well-organized, and useful notes
- Keep a notebook for every course, including notes and assignments
- Construct clear, well-organized, and useful outlines
- Organize information in categories, rank order, and label groups accordingly
- Use book covers, title pages, tables of contents, indexes, and other parts of books to get information
- Locate books in the school and other public libraries, using signs, layout maps, card and computerized catalogues
- Use a variety of paper, on-line and CD-ROM based reference sources, including encyclopedias, indexes, almanacs, handbooks, newspapers, and other periodicals; use telecommunications to share information and exchange ideas
- Identify and use additional sources of information outside of school
- Study and prepare for tests in an organized, strategic manner, including the use of study aids
- Plan for and complete tests in an effective and strategic manner

- STRAND #6 - VIEWING

6th Grade	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade
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Standard: Students understand, analyze, evaluate, and respond effectively to visual presentations. They:

- Recount the story elements of television programs, films, and other productions
- Identify the intended purposes and messages of advertisements, entertainment programs, and news programs
- Identify the format of television programs, films, and other productions
- Give reasoned arguments for selecting or rejecting particular television programs, films, and other productions
- Identify persuasive techniques and stereotyping used by the media and in advertising
- Evaluate what is being viewed
- Understand and evaluate the elements of a visual production, including gesture, facial expression, eye focus, stance, tone, volume, pitch, inflection of voice, pace of speech, pausing, and setting
- Understand and evaluate the techniques of media production, including lighting, music, camera angles, special and sound effects, fade-outs, voice-over

- STRAND #7 - PERSPECTIVE-TAKING & CONFLICT-RESOLUTION SKILLS

6th - 8th Grades

Standard: Students understand and express different points of view. They...

- express someone else's view of their relationship
- take and understand a third person "viewing" point of view
- understand enduring attitudes and values
- understand cultural context

9th - 12th Grades

Standard: Students understand and express different points of view. They...

- locate their own viewpoint in an historical and social context
- distinguish between conscious and unconscious reasons for behavior
- compare and contrast their own viewpoint with major social viewpoints

Standard: Students employ a variety of conflict-resolution strategies. They...

- collaborate with other people and agree on what is most important to each of them
- can prioritize items of importance with other people
- "split the difference", look for the "common ground"

Standard: Students employ a variety of conflict-resolution strategies. They...

- brainstorm new, creative solutions which go beyond their original positions
- trust other people and work collaboratively
- are flexible, willing to let go of old positions, willing to explore new solutions with others

Student Requirements: English Language Arts, Ninth Grade

As a condition of course completion, students will.....

- Complete all course requirements, as outlined by the teacher.
- Pass the citywide Curriculum Test for the course (not a requirement for 1996-97).
- Successfully complete the following Portfolio Products*:

(Note: Teachers are encouraged to work with colleagues to combine these with products from other subject areas.)

- **Reading Reviews:** Students read, understand, and review four books, and at least ten other selections (poems, short stories, articles, plays, etc.), in depth. The books will include literature from at least three different cultures. The other selections will include traditional and contemporary works from at least five different writers (male and female), five genres, and a variety of cultures. To demonstrate understanding of the books (and other selections), students will write their personal reflections on the books, personal questions that have emerged, and answers to the following "key questions":

- How does the author use characters, setting, language, and events to develop the story and lessons?
- What dilemmas did the main character have to face?
- Choose a particular line or passage from the book that reveals the main character's dilemma. How does the author's choice of words communicate the extent of this dilemma?
- What character do you most identify with and why? How are you most like this character? How are you different?
- How are one or more of the events like experiences you have had?
- What is a line of dialogue from the book or play that reflects your beliefs or views? When could you see yourself using this line?
- What in the book or play is important to its time and place, and what is universal? Cite two or three examples.
- How would you change any part of this story?
- What lessons did you learn from this story?
- Would you recommend this book to someone else? Why or why not?

(Note: Teachers will select particular key questions students will answer for each book. Students must *be able to* answer all of these questions for each book. Additional book-specific key questions are being written for those books included on the Core Literature list.)

Each student keeps a literature notebook for their required readings. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Self-Assessment/Goal Setting:** Students describe their strengths and weaknesses based on an overview of their lives and experiences. Based on this self-assessment, they identify and explain their goals for high school and after high school, in as much detail as possible, and the specific plans they have for achieving these goals during their high school years.

- **Essay - Considering Many Points of View:** Students write a succinct essay on a provocative subject or issue of interest to them which is related to one of the required readings. Students consider two points of view on the subject or issue. They demonstrate that they understand the social and cultural context of each position. They refute one of them, and take a position on the other, supporting this position with evidence.

- **Letter - Advice for Eighth Graders:** Students write (and send) letters to eighth grade students, reflecting on their first year in high school, describing in detail the social and cultural context of high school, and suggesting ways middle school students can prepare for their first year in high school.

- **Presentation:** Students present their response to a "key question" related to one of the required readings, including frequent references to the literature. They entertain questions from other students (who will also be assessed on the quality of their questions). As a part of the presentation, students recite, from memory, a favorite line or brief passage, and explain their reasons for selecting this line or passage.

- **In-Depth Literature Study:** Students explore one of their required readings in-depth. They write a paper of four to six pages that builds from one or more of the "key questions", or a research question of their own choice. The paper includes
 - a thesis statement
 - evidence in support of the thesis, drawn from the work and others' analyses of it
 - perceptive connections between the book and real life experiences (theirs and others')
 - a conclusion that addresses the research question and thesis statement.
 A significant aspect of this paper is the development of the student's ideas and reflections on the work.
- **Perspective Taking Exercise - Gender and Point of View:** Students interview their partners about how people their age meet and begin relationships with other people of both genders. They explore and brainstorm various ways in which they can meet new people and begin relationships. They discuss the influence of gender on each other's views of relationships. Students stand in front of the class "in their own shoes", present their own points of view, and discuss the influence of their gender on their point of view. They then stand in the shoes of another student and present that student's views using the first person voice. The emphasis for grades nine through twelve is on helping students place their point of view in a broader societal context.
- **Conflict Resolution Exercise: Using Cooperation.** Students discuss a conflict from one of their books with their partners. Next, they roleplay or write about how they would resolve the conflict or problem. They use the Ask, Brainstorm, Choose (ABC) approach to conflict resolution, with an emphasis on identifying cooperative strategies in which both partners find a new solution which goes beyond their original positions. The emphasis for grades nine through twelve is on developing the students' ability to go beyond compromise approaches to conflict and to develop new approaches which meet both parties' needs. (see *Voices of Love and Freedom Teacher Guides* for additional directions)
- * All students are expected to complete Reading Reviews during the 1996-97 school year. In addition, teachers, working together by grade level or school, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, and conflict-resolution; and one additional product that focuses on writing, that all students in that grade or school will successfully complete during the 1996-97 school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Student Requirements: English Language Arts, Tenth Grade

As a condition of course completion, students will....

- Complete all course requirements, as outlined by the teacher.
- Pass the citywide Curriculum Test for the course (not a requirement in 1996-97).
- Successfully complete the following Portfolio Products*:
(Note: Teachers are encouraged to work with colleagues to combine these with products from other subject areas.)

- **Reading Reviews:** Students read, understand, and review four books, and at least ten other selections (poems, short stories, articles, plays, etc.), in depth. The books will include literature from at least three different cultures. The other selections will include traditional and contemporary works from at least five different writers (male and female), five genres, and a variety of cultures. To demonstrate understanding of the books (and other selections), students will write their personal reflections on the books, personal questions that have emerged, and answers to the following "key questions":

- How does the author use characters, setting, language, and events to develop the story and lessons?
- What dilemmas did the main character have to face?
- Choose a particular line or passage from the book that reveals the main character's dilemma. How does the author's choice of words communicate the extent of this dilemma?
- What character do you most identify with and why? How are you most like this character? How are you different?
- How are one or more of the events like experiences you have had?
- What is a line of dialogue from the book or play that reflects your beliefs or views? When could you see yourself using this line?
- What in the book or play is important to its time and place, and what is universal? Cite two or three examples.
- How would you change any part of this story?
- What lessons did you learn from this story?
- Would you recommend this book to someone else? Why or why not?

(Note: Teachers will select particular key questions students will answer for each book. Students must *be able to* answer all of these questions for each book. Additional book-specific key questions are being written for those books included on the Core Literature list.)

Each student keeps a literature notebook for their required readings. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Character Comparison:** Students compare and contrast themselves, or an experience they have had, with a character or event from one of their required readings. They describe the differences in social and cultural context and the effect of the contexts on themselves and the characters. Students make frequent references to the literature and their experiences.
- **Essay - Writing an Editorial on a School Policy:** Students write a succinct editorial on a school policy of concern to many members of the school. They briefly describe the particular policy, identify problems with it, and make specific recommendations for changes. The students' editorials are collected and submitted to the school's administration, requesting a response, orally or in writing.
- **Letter:** Students write a letter to someone, responding to something that person believes or has done that the student supports or disagrees with. The student makes recommendations for changes she or he would like the person to consider.
- **Debate:** Students, working in pairs, debate the qualities, faults, and other characteristics of a character from one of their required readings. Students are assigned a perspective ("admirer" or "critic"). They present a position in support of their assigned perspective, and support their position with specific references to the book. They entertain questions from other students (who will also be assessed on the quality of their questions).

- **In-Depth Character Sketch:** Students explore a character from one of their required readings, in-depth. They write a paper of no fewer than six pages including:
 - a thesis statement
 - a description of the character, including the character's faults, redeeming qualities, and actions
 - evidence in support of the thesis, drawn from the work and others' analyses of it
 - perception connections between the character and other familiar characters or real-life people
 - a conclusion that addresses the thesis statement.

A significant aspect of this paper is the development of the student's ideas and reflections on the character.

- **Perspective Taking Exercise - Culture and Point of View:** Students describe their own cultural backgrounds and interview two students from different cultural backgrounds other than their own. They explore and brainstorm various ways in which they can get to know each other better. They stand in front of the class "in their own shoes" and present their own point of view and the influence of their cultural background on their point of view. They then stand in the shoes of the students they interviewed and present their points of views on the same issues in the first person voice.
- **Conflict Resolution Exercise - Racial and Ethnic Conflict:** Students, working in pairs, discuss racial and ethnic conflicts that have occurred in their schools or neighborhoods. They use the Ask, Brainstorm, Choose (ABC) approach to define the conflicts, explore options for resolving the conflict, and decide upon the best option. Each student presents his or her own proposal for resolving racial or ethnic conflict to the class. (see Voices of Love and Freedom Teacher Guides for additional directions)
- * All students are expected to complete Reading Reviews during the 1996-97 school year. In addition, teachers, working together by grade level or school, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, and conflict-resolution; and one additional product that focuses on writing, that all students in that grade or school will successfully complete during the 1996-97 school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Student Requirements: English Language Arts, Eleventh Grade

As a condition of course completion, students will.....

- Complete all course requirements, as outlined by the teacher.
- Pass the citywide Curriculum Test for the course (not a requirement in 1996-97).
- Successfully complete the following Portfolio Products*:
(Note: Teachers are encouraged to work with colleagues to combine these with products from other subject areas.)

- **Reading Reviews:** Students read, understand, and review four books, and at least ten other selections (poems, short stories, articles, plays, etc.), in depth. The books will include literature from at least three different cultures. The other selections will include traditional and contemporary works from at least five different writers (male and female), five genres, and a variety of cultures. To demonstrate understanding of the books (and other selections), students will write their personal reflections on the books, personal questions that have emerged, and answers to the following "key questions":

- How does the author use characters, setting, language, and events to develop the story and lessons?
- What dilemmas did the main character have to face?
- Choose a particular line or passage from the book that reveals the main character's dilemma. How does the author's choice of words communicate the extent of this dilemma?
- What character do you most identify with and why? How are you most like this character? How are you different?
- How are one or more of the events like experiences you have had?
- What is a line of dialogue from the book or play that reflects your beliefs or views? When could you see yourself using this line?
- What in the book or play is important to its time and place, and what is universal? Cite two or three examples.
- How would you change any part of this story?
- What lessons did you learn from this story?
- Would you recommend this book to someone else? Why or why not?

(Note: Teachers will select particular key questions students will answer for each book. Students must *be able to* answer all of these questions for each book. Additional book-specific key questions are being written for those books included on the Core Literature list.)

Each student keeps a literature notebook for their required readings. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Autobiography - Looking at Yourself from the Perspective of a Character:** Students complete a narrative work describing and reflecting on an experience from their lives, from the perspective of a character from one of their readings. They consider the social and cultural context of the experience, as well as the conscious and unconscious reasons for their thoughts and actions.
- **Essay - A Letter to the Editor:** Students write and submit a succinct response to an editorial they have read in a newspaper or periodical that is related to issues raised in the required readings.
- **Letter - Addressing a School Problem:** Students write (and send) a letter to their principal about a problem they would like to resolve with him/her. They describe the problem and their point of view about the causes of the problem. They ask the principal to describe his/her views about the causes of the problem, in writing or in person. After receiving the principal's response (or in their discussions with him/her) the students compare and contrast their points of view and suggest collaborative solutions to the problem.
- **Public Speaking Activity:** Students present a draft plan for a project to improve some condition in their school or community, or they present a prototype of a product they'd like the students (or other consumers) to purchase. They receive and answer students' questions, and they solicit responses to the presentation, seeking recommendations for improvements to the content and their delivery.

- **In-Depth Literature Study/Peer Review:** Students explore one particular work of literature in-depth. They produce and present a paper of no fewer than eight pages that builds from a research question they have selected. The paper includes:
 - a thesis statement
 - substantial evidence in support of the thesis, drawn from the work and others' analyses of it
 - perceptive connections between the book and real-life experiences (theirs or others)
 - a conclusion that addresses the research question and thesis statement.
 At least one other student familiar with the work of literature reads and comments on the paper, orally and in writing, using a task description s/he's familiar with to guide his/her assessment of the paper. This students' written comments are assessed by the teacher.
- **Facilitation:** Each student facilitates a class discussion. They ensure that all voices are heard; students remain on-task; no students dominate the discussion; the language remains polite and constructive; disagreements are managed in a constructive manner; and the discussion comes to a productive close, including closing reflections on the key points that were made, and the lessons that were learned.
- **Perspective Taking Exercis: Class and Point of View.** Students discuss how their economic status may influence their points of view. They then interview another student from different economic circumstances, possibly a student from another neighborhood or school district about the same issues. They make a presentation to the class standing "in their own shoes" and presenting their own understanding of how their economic status has influenced them. They then stand in the shoes of the student they interviewed and present his or her point of view using the first person voice.
- **Conflict Resolution Exercise: Poverty and Violence.** Students explore the relationship between economics and violence in the major cities of the United States. They define the problem, propose alternative solutions and decide on a proposed solution. The emphasis is on solutions which go beyond traditional approaches, e.g., more jobs, or more prison cells.
- * All students are expected to complete Reading Reviews during the 1996-97 school year. In addition, teachers, working together by grade level or school, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, or conflict-resolution; and one additional product that focuses on writing, that all students in that grade or school will successfully complete during the 1996-97 school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Student Requirements: English Language Arts, Twelfth Grade

As a condition of course completion, students will.....

- Complete all course requirements, as outlined by the teacher.
- Pass the citywide Curriculum Test for the course (not a requirement of 1996-97).
- Successfully complete the following Portfolio Products*:

(Note: Teachers are encouraged to work with colleagues to combine these with products from other subject areas.)

- **Reading Reviews:** Students read, understand, and review four books, and at least ten other selections (poems, short stories, articles, plays, etc.), in depth. The books will include literature from at least three different cultures. The other selections will include traditional and contemporary works from at least five different writers (male and female), five genres, and a variety of cultures. To demonstrate understanding of the books (and other selections), students will write their personal reflections on the books, personal questions that have emerged, and answers to the following "key questions":

- How does the author use characters, setting, language, and events to develop the story and lessons?
- What dilemmas did the main character have to face?
- Choose a particular line or passage from the book that reveals the main character's dilemma. How does the author's choice of words communicate the extent of this dilemma?
- What character do you most identify with and why? How are you most like this character? How are you different?
- How are one or more of the events like experiences you have had?
- What is a line of dialogue from the book or play that reflects your beliefs or views? When could you see yourself using this line?
- What in the book or play is important to its time and place, and what is universal? Cite two or three examples.
- How would you change any part of this story?
- What lessons did you learn from this story?
- Would you recommend this book to someone else? Why or why not?

(Note: Teachers will select particular key questions students will answer for each book. Students must *be able to* answer all of these questions for each book. Additional book-specific key questions are being written for those books included on the Core Literature list.)

Each student keeps a literature notebook for their required readings. The notebook will be reviewed on a regular basis and serve an important role in student-teacher-parent-administrator conferences.

- **Autobiography - The Most Important Experience in High School:** Students describe the most important experience of the past four years. They also select a book that was most important to them. They describe, in detail, how this experience and this book have influenced who they are. Students include specific references to the book to illustrate their descriptions. Students place these personal experiences in a broader context, describing how they will help to shape their future as family members, workers, and responsible participants in their communities.
- **Essay - Arguing for a New Point of View:** Students write an essay in which they compare and contrast two or more points of view. They describe the social and cultural context of each position, and then propose their own alternative that synthesizes and improves on the other points of view. They support their position with substantial evidence.
- **Letter - A Letter of Introduction:** Students prepare a resume and a letter of introduction reflecting on their skills and experiences, to be used as part of an application to school or for work. The letter of introduction describes their strengths and their goals for the future.
- **Portfolio Presentation:** As a culminating, Senior year activity, students select a work from their portfolio they will present to their class. In their presentation, students express why this work is of such value to them, and why they have selected this work to share with others. Wherever possible, the work will be xeroxed and distributed to other students in the class, in advance.

- **In-Depth Literature Study/Peer Review/Oral Defense:** Students explore one particular work of literature in-depth, its author, and the analysis of that work by at least one literary critic. They produce and present a paper of no fewer than ten pages that builds from a research question they have selected. The paper includes:
 - a thesis statement
 - substantial evidence in support of the thesis, drawn from the work and others' analyses of it
 - perceptive connections between the book and its author: his/her life, other works, opinions et al.
 - a challenge to, or critical probing of, one critic's interpretation of the work, or some portion of it
 - a conclusion that addresses the research question and thesis statement.
 Each student will team with two other students who are familiar with the book, to read their respective papers, and to present, discuss, and defend their positions and interpretations. Each partner will write a commentary on the others' papers, using a task description they're familiar with to guide their assessment of the paper. They will also prepare three challenging questions, to be presented to the writer when the team discusses one another's papers. Students' written comments and questions will be assessed by the teacher.
- **Perspective Taking Exercise - My Partner's Story:** Students tell their partners about the most important experiences in their lives. They demonstrate all the different perspective-taking skills in their story. Next, they stand in front of the class in their partner's shoes and tell the class their partner's story.
- **Conflict Resolution Exercise - High Stakes Role-Play:** Partners role-play a high-stakes situation (e.g. job or college interview; dinner with the boss; a volatile situation in school, at home, or on the street) in which they have to assess the conditions and the expectations of their audience or adversaries, and communicate and present themselves in a manner appropriate to the situation. Students demonstrate their ability to understand the other persons' needs and point of view, and to select the most appropriate strategy to handle the situation. Students demonstrate an understanding of all the different conflict resolution strategies.
- * All students are expected to complete Reading Reviews during the 1996-97 school year. In addition, teachers, working together by grade level or school, will select one additional product that focuses on listening, speaking, presenting, perspective-taking, or conflict-resolution; and one additional product that focuses on writing, that all students in that grade or school will successfully complete during the 1996-97 school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives: English Language Arts, 9th-12th Grade

Overview: Students will discuss and understand the content, themes, and structure of each of the stories, books, poems, articles, and other works they read. Students will reflect on the key concepts included in the literature; deepen their understanding of literary conventions; make connections between their readings, their personal experiences, and the experiences of others; and complete a variety of products to share their new understandings with others.

Core Literature: A Core Literature list, including a single required book for each grade level, and additional recommended books differentiated by grade-level (to ensure that students are not reading the same books year after year), is enclosed. Additional books will be added to the list next year.

A minimum of four complete books should be taught in every English class each year. These four books should come from the Core Literature list by school year 1998-99 (or earlier, if funds can be identified to purchase these books for each school).

Key Concepts: Teachers should identify the key topics, themes, and literary conventions for each book a student reads. Students should be able to explain the topics, themes, and conventions, citing examples from the literature and personal experiences. (The following example is for Shakespeare's, Hamlet, a book that will be included in the Core Literature for the twelfth grade.)

Topics: Tragic Flaw (in a character); Confronting Loss; Suicide

Literary Conventions: Students will understand the form and nature of tragedy

Themes*: Students will understand...

- the nature of kinship, the powerful bonds of relationships, and the enduring and often unavoidable struggles that are unique to families;
- that people must confront and address unpleasantness, pain, and anguish; that you should not run from your problems;
- that some literature embodies universal issues regardless of the time or place of its creation.

*Theme: the key lesson(s) the author is trying to convey; the "moral to the story"; the author's position on the book's key topic(s)

Key Questions: Key questions are thought-provoking, often open-ended questions that stimulate students' development of a deep understanding of a work of literature or other reading selection. Students will write and/or present insightful responses to the following key questions about the selections they read, citing references to the work and their own experiences. Teachers may select particular questions to emphasize for each work the students read.

Fiction/Biography/Autobiography:

• **Topic:**

What is this book/chapter all about?

- **Theme:** the key lesson(s) the author is trying to convey; the "moral of the story"; the author's position on the book's key topic(s). Example: "Topic": Friendship; "Theme": Friendship has obligations.

What lessons is the author trying to teach?

How does the theme apply to your life?

Do you agree or disagree with the author's point of view?

• **Plot:**

What are the most memorable or significant events? Why these?

What role did they play in developing the theme?

What's going to happen next? Did it?

• **Characterization:**

Who are the most important characters? What makes them so important?

How do they help to develop the theme?

What are their key characteristics?

• **Conflict:**

What challenges are the key characters wrestling with?

How are they responding to them?

How should they respond? How would you respond?

- **Setting:**
How do location, time, and culture affect the characters and plot?
What role do they play in developing the theme?
Would the story be different in another location, time, or culture?
- **Language:**
How does the author's use of language enhance the story?
- **Connections:**
What comparisons can you make between characters and events in the book/chapter, yourself, and contemporary characters/events you're familiar with?
- **Significance:**
Why is this book important?
Is there anything unique about this book? Is there anything difficult or challenging?
Would you recommend this book to a friend? Why or why not?
- **General:**
What are the most interesting things you learned?
What surprised or amazed you?
How would you change any part of this chapter? How would this change affect the story?

Non-Fiction (Articles/Editorials/Essays/Speeches et al.):

- **Purpose**
What is the author's purpose?
- **Topic**
What is the main topic?
- **Point of View**
What is the author's point of view?
How well does the author present and support his/her point of view?
What facts, opinions, assumptions, interpretations, and/or beliefs does s/he present?
- **Credibility**
Is the author believable?
What important questions remain unanswered?
- **General**
What did you learn?
Would you recommend this reading to someone else? Why or why not?

In addition, teachers should identify particular book/selection-specific "key" questions that are open-ended, thought-provoking and engaging to students, and essential to developing a deep understanding of the major themes or ideas in the reading. Teachers should select particular key questions students will respond to for each selection they read, from those listed above, from others they have developed, and from additional questions students are interested in.

The following example of some book-specific questions is for Shakespeare's Hamlet.

- What makes Hamlet a tragedy and not a soap opera?
- Are Hamlet's thoughts of suicide justifiable?
- Why doesn't Hamlet "sweep to (his) revenge"?
- What does Hamlet teach us about family relationships?
- What does Hamlet's relationship with Horatio teach us about the nature of friendship?
- What topics/themes did Shakespeare explore and what does he suggest about these topics/themes?

**Boston Public Schools
Core Literature List, 1996-97
English Language Arts**

Grade 4

1. Yang the Youngest and His Terrible Ear* - Namioka
2. Abel's Island - Steig
3. Charlotte's Web - White
4. Koya Delaney and the Good Girl Blues - Greenfield
5. My Name is Maria Isabel - Ada
6. Sarah, Plain and Tall - McLachlan
7. Sadako and the 1000 Paper Cranes - Coerr
8. Song of Trees - Taylor
9. The Fighting Ground - Avi
10. The Hundred Dresses - Estes
11. The Magic Shell - Mohr
12. A Boy Becomes a Man at Wounded Knee - Wood

Grade 5

1. Mississippi Bridge* - Taylor
2. Dear Mr. Henshaw - Cleary
3. Felita - Mohr
4. In the Year of the Boar and Jackie Robinson - Lord
5. Journey to Jo'burg - Naidoo
6. Kid in the Red Jacket - Park
7. Crossing the Starlight Bridge - Mead
8. Onion Tears - Kidd
9. Pride of Puerto Rico - Walker
10. Shiloh - Naylor
11. Sojourner Truth, "Ain't I a Woman?" - McKissick
12. Starfisher - Yep
13. The Real Thief - Steig

Grade 6

1. Gift Giver* - Hansen
2. Roll of Thunder, Hear My Cry - Taylor
3. So Far from the Bamboo Grove - Kawashima Watkins
4. Clay Marble - Fong Ho
5. Number the Stars - Lowry
6. Bridge to Terabithia - Paterson
7. Maniac Magee - Spinelli
8. Going Home - Mohr
9. Taking Sides - Soto
10. Guests - Dorris

Grade 7

1. Let the Circle be Unbroken* - Taylor
2. Young Landlords - Myers
3. Taste of Salt - Temple
4. Dragonwings - Yep
5. Goodbye, Vietnam - Whelan
6. Homecoming - Voight
7. Monkey Island - Fox
8. Grab Hands and Run - Temple
9. Among the Volcanoes - Castaneda
10. When Thunders Spoke - Sneve
11. Scorpions - Myers

Grade 8

1. The Giver* - Lowry
2. Hoops - Myers
3. Year of Impossible Goodbyes - Nyul Choi
4. Dragon's Gate - Yep
5. Children of the River - Crew
6. Dicey's Song - Voight
7. Journey of the Sparrows - Buss
8. Lyddie - Patterson
9. Growing Up Inside the Sanctuary of My Imagination - Mohr
10. High Elks Treasure - Sneve
11. Road to Memphis - Taylor
12. Harriet Tubman - Petry

Grade 9

1. A Raisin in the Sun* - Hansberry
2. Narrative of the Life of Frederick Douglass - Douglas
3. Romeo and Juliet - Shakespeare
4. Animal Farm - Orwell
5. The Miracle Worker - Gibson
6. Of Mice and Men - Steinbeck
7. Annie John - Kincaid
8. April and the Dragon Lady - Namioka
9. One Bird - Mori
10. Bless Me, Ultima - Anaya
11. Jesse - Soto
12. Night Flying Woman - Broker

Grade 10

1. Night* - Weisel
2. Black Boy - Wright
3. Antigone - Sophocles
4. To Kill a Mockingbird - Lee
5. The Fire Next Time - Baldwin
6. The Friends - Guy
7. Flowers for Algernon - Keyes
8. Teacup Full of Roses - Mathis
9. Rice Without Rain - Ho
10. The Honorable Prison - de Jenkins
11. The House on Mango Street - Cisneros
12. Mountain Windsong - Conley
13. Smoke Rising - Bruchac
14. Farewell to Manzanar - Wakatsuki Houston

* 1996-97 Citywide Required Reading

**Boston Public Schools
Core Literature List, 1996-97
English Language Arts
(continued)**

Grade 11

1. I Know Why the Caged Bird Sings* - Angelou
2. Their Eyes Were Watching God - Hurston
3. The Crucible - Miller
4. The Piano Lesson - Wilson
5. Death of a Salesman - Miller
6. The Scarlett Letter - Hawthorne
7. My Antonia - Cather
8. China Boy - Lee
9. The Joy Luck Club - Tan
10. An Island Like You - Ortiz Cofer
11. In Nueva York - Mohr
12. Love Medicine - Erdrich

Grade 12

1. Hamlet* - Shakespeare
2. The Autobiography of Malcom X - Haley
3. Oedipus, the King - Sophocles
4. Song of Solomon - Morrison
5. Incidents in the Life of a Slave Girl - Jacobs
6. The Women of Brewster Place - Naylor
7. Frankenstein - Shelley
8. Love, Stars and All That - Narayan
9. In the Time of the Butterflies - Alvarez
10. Ceremony - Marmon Silko
11. The Grass Dancer - Power
12. The House of the Spirits - Allende

* 1996--97 Citywide Required Reading

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**Mathematics
Middle and High School**

**Version 96.1
June 28, 1996**

THE BOSTON PUBLIC SCHOOLS
CURRICULUM FRAMEWORK
MIDDLE AND HIGH SCHOOL
MATHEMATICS

Boston Public Schools Citywide Learning Standards and Curriculum Framework Middle and High School Mathematics

Version 9.0.1
June 28, 1998

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BPS Learning Standards and Curriculum Framework: Mathematics

Introduction:

This document is a guide to the Boston Public Schools mathematics standards. The standards are designed to create consistency and continuity across the grade levels, set parameters for the designation of instructional time, and most importantly, improve the mathematics education of all students in the Boston Public Schools.

Guiding Principles:

There are underlying beliefs and tenets that are central to the vision of mathematical power and the content standards for mathematics education:

- Students should explore mathematical ideas in ways that maintain their enjoyment of and curiosity about mathematics, help them develop depth of understanding, and reflect real-world applications.
- All students should have access to a high quality mathematics program.
- Mathematics learning is a lifelong process that begins and continues in the home and extends to the school and community settings.
- Mathematics instruction should make connections with other disciplines, within mathematics, and to real-world situations.
- Working together in teams and groups enhances mathematical learning, helps students communicate effectively, and develops social and mathematical skills.
- Technology is an essential tool for effective mathematics education.
- Mathematics assessment is a multifaceted tool that monitors student performance, improves instruction, enhances learning, and encourages student self-reflection.

(1996 Massachusetts Mathematics Curriculum Framework)

Core Processes:

The Boston Public Schools Citywide Learning Standards for Mathematics build upon the Massachusetts Mathematics Curriculum Framework's core concept that students develop mathematical power through problem-solving, communication, reasoning, and connections. These concepts are elaborated on further at the beginning of the Pre K-5 and 6-12 Learning Standards.

- **Problem Solving:** Problem solving is the central focus of mathematics education. Whenever we apply our mathematics knowledge, skills, or experiences to the resolution of a dilemma or situation that is new or perplexing, we are problem solving.
- **Communication:** Students learn mathematics best when they talk and write about what they are doing. Communication in mathematics promotes mathematical understanding and creates mathematical power.
- **Reasoning:** Mathematics reasoning is necessary if we are to know and do mathematics. The ability to reason enables students to solve problems in their lives, in and outside of school. Students need to be provided with opportunities to make conjectures, think about and select sensible ways to solve problems, justify their solutions, and share their reasoning with others. They also need to experience, recognize, learn, and use different types of reasoning.
- **Connections:** Mathematics topics are connected to real life and to one other. Students should understand how mathematics relates to other subject areas. For example, all students should understand the concepts of location and place, each of which is important to both geography and mathematics. Students should appreciate that mathematics is one way of learning about the world, and that it is connected, not isolated, from other ways of learning. Students need to see that many problems in the world, when examined initially, appear quite different; but when we model these same problems mathematically, they have striking similarities.

Organizational Structure:

Our standards are organized by "strands" that are included in the Massachusetts Curriculum Frameworks. These strands include:

1. Number Sense
2. Patterns, Relations, and Functions
3. Geometry, Spatial Sense, and Measurement
4. Probability, Statistics, and Discrete Mathematics

This organization promotes an "integrated" approach to mathematics.

Integrated Mathematics:

An integrated approach to teaching mathematics means making connections within mathematics, as well as to other disciplines and real world situations. In an "integrated mathematics" program, students are taught increasingly sophisticated concepts from different strands of mathematics, including arithmetic, algebra, geometry, probability, and statistics. Measurement is related to number, data, and geometry; and algebraic ideas of patterns and relationships are developed in all areas of mathematics. This process begins in the early grades and continues throughout high school.

Students learn to solve real-life problems that require the integration of skills from two or more of these mathematics strands. Skills, concepts, and procedures are taught through authentic tasks as an integrated whole, not in isolation of one another. Concepts are taught over a long period of time, and connected to a variety of strands.

For example, the concept of fractions should be explored and taught a number of times throughout the school year:

- as parts-to-whole (geometry)
- as the comparison of two quantities (number sense, ratio)
- as the comparison of a particular quantity with a fixed quantity (decimals and percent)
- as the comparison of two comparisons (ratio and proportion)
- through the application of fractions as rates one can investigate (probability and statistics)

When students are exposed to and use fractions in the many ways they are commonly used in the real world, they can become far more proficient problem-solvers.

Beginning in 1998, students throughout Massachusetts will take statewide assessments in mathematics. These assessments will reflect the integrated approach adopted by the state. We are aligning our standards with this approach to prepare our students for these assessments.

Finally, the integrated approach is not new. In most European countries, mathematics is taught in an integrated manner. For example, there is no artificial separation of algebra and geometry. By the same token, math instruction in many of our classrooms is already integrate. Effective teachers, particularly at the elementary and middle school levels, have been using an integrated approach to mathematics instruction for years. For example, even very young children begin to study shapes and sizes during the primary grades, though the language of geometry may not be used. Many Boston middle schools already introduce algebra concepts through an integrated approach. All of this work will continue, and be supported by an integrated approach across all levels.

Key Characteristics:

The following principles define our standards' key characteristics.

- Accessible: Our standards are accessible to the children in the Boston Public Schools.

- **Rigorous**: Our standards are challenging. In addition to requiring the mastery of facts and procedures, we expect students to know the meaning of computation and operations. Students are required to move beyond the intuitive and concrete level of understanding, to the representational, abstract, application, and communication levels. Mastery is achieved only when a student is able to communicate his or her learning.
- **Meaningful**: Our standards require students to make meaningful connections between their classroom and the world outside of school. The standards demonstrate to students that learning mathematics is a life-long process, and its purpose is to solve real problems.
- **Inquiry-Centered**: Our standards promote experiences that are exploratory and discovery-oriented. Students should be encouraged to persist and take risks, be actively engaged, and feel confident in their ability to do mathematics. Though students will make many mistakes along the way, we view these mistakes as opportunities to learn, particularly when they are discussed with other students and the teacher.
- **Communication and Reflection-Centered**: Mathematics is a language to be learned, with its own vocabulary, syntax, and rules of translation from language to symbol (and vice-versa). We expect students to explore and reflect on concepts and procedures, to express their mathematics understandings clearly, through speech and writing, and to develop their reading skills, as related to mathematics.
- **Student Focused/Appropriately Paced**: Some students need more time to master the concepts included in our standards. Our standards framework responds to these needs. Every student will graduate with a solid foundation in arithmetic, algebra, geometry, probability, and statistics. Some students will also graduate with a solid foundation in calculus.
- **Concrete**: Our standards provide teachers and students with concrete example of problems, tasks, and products students will be expected to solve and complete.
- **Assessment-Embedded**: Assessment is an integral part of the mathematics program, and is aligned with curriculum and instruction. A variety of methods such as performance tasks, projects, observations, discussions, writings, etc. are used to measure and monitor student performance, enhance learning, and improve instruction.

Mathematics assessment also encourages student reflection. Students are expected to take increasing responsibility for organizing and extending tasks into projects and long-term activities. They will select and organize mathematics and resources, extend work to related tasks, review their progress, and check and evaluate their work. Throughout this process, students will develop confidence, perseverance, and persistence by continuing to work on problems that pose challenges.

- **Technological**: Our standards require students to understand and use appropriate instructional technology, including calculators, computer software, graphing utilities, statistics packages, and different types of measuring devices, to enhance and accelerate mathematics learning, to represent and communicate mathematical ideas, and to make mathematics more accessible to all children. Appropriate technologies will be used in the spirit of manipulatives to make presentations, carry out explorations, and assess mathematical concepts and skills.
- **Open-Ended**: As children need more and more mathematics to be successful in life, as we learn more about the way children learn mathematics, and as instructional methodologies get better, our standards and curriculum need to keep pace with these changes. Our standards are designed to be implemented, reviewed, and revised, as needed, on an ongoing three to five year cycle.

Core Processes: Mathematics, Grades 6-12

Problem-Solving: Students will...

- formulate and solve real world problems
- solve multi-step problems with multiple solutions or no solution
- develop, use, and evaluate a variety of strategies (i.e. trial and error, break complex problem into series of tasks, etc.) to solve problems
- recognize problems where more information is needed; identify additional information needed
- use problem solving approaches to investigate and understand content from other strands
- select, use, and organize appropriate mathematics, equipment, and materials in solving problems
- develop different mathematical approaches and look for ways to overcome difficulties
- organize and check individual and group work
- apply knowledge, understanding, and skills of mathematics and other disciplines to solve problems of increasing complexity and in a variety of contexts
- use a wide range of methods of computation to solve problems

Reasoning: Students will...

- verify and interpret results
- demonstrate that a problem can be solved in more than one way; justify one's thinking
- draw conclusions using inductive and deductive reasoning
- encounter and consider different lines of mathematical argument: deductive, inductive, quantitative, geometric, spatial, statistical, analogical, etc.
- reason by analogy
- use models, known facts, properties, and relationships to explain thinking
- explain thinking, conjectures, solution processes, and answers
- make generalizations and hypotheses; design ways to test them; analyze results
- generalize solutions to new problem solving situations
- examine own and other's reasoning about mathematics
- present, justify, and defend mathematical thinking (conclusions and solutions)
- interpret and evaluate mathematics that is presented in a variety of forms (numerical, graphical, algebraic, geometrical, etc.)
- appreciate the difference between mathematical explanations and experimental evidence
- appreciate and use logical connectives and hypothetical questions (i.e. "if...then..."), and recognize inconsistencies
- show increasing ability to understand and apply algebraic reasoning processes and spatial reasoning

Communication: Students will...

- develop mathematical communication and skills in the context of other strands
- relate everyday language to mathematical language and symbols
- discuss, illustrate, and write about mathematical concepts and relationships
- use language to reflect on, clarify, and articulate thinking about mathematical ideas and situations
- demonstrate mathematical communication through discussion, representation (i.e. tables, graphs, computer print-outs, symbols, etc.), reading, writing, listening, and responding (individually and in groups)
- discuss work; respond to and ask questions appropriate to given grade level
- develop linguistic, conceptual, and procedural understanding
- express mathematical ideas, skills, and discoveries through conversations, experimentation, drawings, graphs, and abstract and concrete representations
- express mathematical ideas through individual as well as collective efforts
- devise and refine ways of recording
- record and present mathematics in a variety of ways
- understand, use, and present language, notation, and mathematical forms of communication

Connections: Students will...

- discover, use, and apply mathematics in practical tasks, in real-life problems, and within mathematics
- search for patterns while working with numbers, data, shapes, and objects in the environment in an integrated manner
- develop mathematical language, and communicate and reason mathematically within and across strands of mathematics (i.e. relate measurement to data and geometry, ratio and proportion to probability and geometry, etc.)

Integration: Students will...

- connect and relate ideas within different mathematics strands and with other concepts and skills that students are learning
- view mathematics as an integrated whole: make connections within and across strands and to other disciplines
- apply knowledge, understandings, and skills of mathematics and other disciplines to problem solving and real world situations in increasing complexity
- concepts and skills should not be taught in isolation of one another nor in fragmented manner such as rote memorization of facts and procedures
- relate measurement to number, data, and geometry
- develop algebraic ideas of patterns and relationships in all areas of mathematics from K-12
- explore and use algebraic, geometric, and statistical ideas of patterns and relationships in all areas of mathematics

Assessment:

- assessment should be an integral part of curriculum and instruction, and should employ a variety of methods, tasks, instruments, contexts, and problems to assess children's learning and achievement in mathematics

Instruction/Technology:

- create a risk-taking environment where students are encouraged to express ideas and experiment
- use a variety of concrete and pictorial materials for presenting concepts and skills
- use a variety of instructional technologies to represent and communicate mathematical ideas (manipulatives, calculators, and computers; video, CD-ROM, and laser disks in the spirit of manipulatives)
- use calculators and computers as means to explain numbers, as tools for calculating with realistic data, and as manipulatives to conceptualize mathematics
- use appropriate technologies in presentation, explorations, and assessment of mathematical concepts and skills
- use graphing calculators and (grades 7-12) and computer software (spreadsheets, Geometric Supposer, Sketchpad, etc.) to explain number and space, as tools for dealing with realistic data, and to conceptualize concepts

BPS Learning Standards: Sixth Grade Mathematics

Strand #1: Number Sense

Number sense is the ability to understand and use numbers and operations on numbers in computation, measurement, and estimation. NTCM Standards)

Number Sense and Number Relationships:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand, represent, and use equivalent forms of numbers (integer, fraction, decimal, percent, exponent, and scientific notation) in the real world and in problem-solving situations.	Objectives: Students... • identify and use place value through billions in standard and expanded forms • demonstrate an understanding of exponents (positive powers only) and apply them in meaningful problem solving situations • identify, describe, and apply the fraction, decimal, and percent equivalencies to each other and for the following percents: 1%, 5%, 10%, 25%, 50%, 100% • identify and describe equivalent representations of concepts (i.e. conversions from fractions to decimals to percents) • demonstrate an understanding of the equivalence of fractions through the use of multiple strategies (i.e. equal ratios, multiplication by 1, etc.)
Standard #2: Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • compare integers, decimals, and fractions using number sentences with $<$, $>$, $=$ • read, write, and understand conceptually integers (+ and -), fractions, and decimals • order integers, decimals, and fractions
Standard #3: Understand and apply ratios, proportions, and percents.	Objectives: Students... • understand and apply ratio (and equal ratios) and proportion to solve problems • understand and use maps and scale drawings
Standard #4: Investigate and describe the relationship among fractions, decimals, and percents.	Objectives: Students... • investigate and describe the relationship among fractions, decimals, and percents
Standard #5: Represent numerical relationships in one- and two-dimensional graphs.	Objectives: Students... • graph ordered pairs • convert numerical patterns from tables to graph form (i.e. multiples: things that come in groups)

Number Sense, Computation, and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Compute with whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • use with understanding effective models and processes of computation (mental, oral, written, calculator, computer, etc) • compute with whole numbers, fractions, decimals, and integers
Standard #2: Develop, analyze, and explain procedures for computation and techniques for estimation.	Objectives: Students... • develop and describe multiple strategies for estimating quantities • round to the nearest ten, hundred, thousand, million, billion • round decimals and fractions to the nearest pre-assigned value • use estimation to solve whole number operations; compute and compare the results • use the associative, commutative, and distributive properties to simplify and estimate computations
Standard #3: Develop, analyze, and explain procedures for solving proportions.	Objectives: Students... • use ratio and proportion to solve problems; describe the procedures used
Standard #4: Select and use an appropriate method for computing from among mental arithmetic, paper and pencil, calculator, and computer methods.	Objectives: Students... • use a variety of approaches for computing and solving problems
Standard #5: Use computation, estimation, and proportions to solve problems.	Objectives: Students... • use estimation to solve problems involving money, length, area, perimeter, and volume
Standard #6: Estimate to check the reasonableness of results.	Objectives: Students... • apply number and algorithmic sense, estimation skills, and a variety of methods to check the reasonableness of computations

Number Sense and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and explain the need for numbers other than whole numbers.	Objectives: Students... • create and solve meaningful problems that require the use of numbers other than whole numbers
Standard #2: Know and use order relations for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • demonstrate an understanding of order and equivalence within decimals (i.e. $.1 = .10 = .100$) • write a number between two given numbers • demonstrate an understanding of order of whole numbers, fractions, decimals, and integers: locate them on a number line; locate a number between 2 given numbers • know and use order of operations including the use of parentheses
Standard #3: Use operations involving fractions, decimals, integers, and rational numbers.	Objectives: Students... • use operations involving fractions, decimals, and integers
Standard #4: Demonstrate how basic operations are related to one another.	Objectives: Students... • identify and describe the equivalent representation of procedures (i.e. demonstrate and describe the relationship of addition for whole numbers, fractions, and decimals) • use concrete and abstract models to understand and describe the mathematical processes underlying the operations of addition, subtraction, multiplication, and division (and their relationship with one another) on fractions, decimals, and integers
Standard #5: Create and apply number theory concepts, including prime numbers, factors, and multiples.	Objectives: Students... • identify and demonstrate an understanding of common multiples, factors, and primes and composite numbers • use prime factorization and experimentation to determine the least common multiple (LCM) and greatest common factor (GCF) of whole numbers • understand and apply divisibility by 2,3,4,5,6,9,10 and multiples of these numbers • demonstrate an understanding of the periodicity of numbers • express a number in different bases; convert from one base to another

Strand #2: Patterns, Relations, and Functions

In the middle school years, the study of patterns and functions should focus on the interpretation, analysis, representation, and generalization of relationships. These topics should first be explored as informal investigations, using diagrams and pictorial representations whenever needed. (NCTM Standards)

Patterns and Functions: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, extend, analyze, and create a wide variety of patterns.	Objectives: Students... • recognize, describe, analyze, extend, and create a wide variety of patterns
Standard #2: Describe and represent relationships with models, tables, graphs, and rules; use sentences and algebraic expressions.	Objectives: Students... • describe and represent patterns using models, tables, graphs, simple rules, and manipulatives such as pattern and algebra blocks • locate ordered pairs to graph 2-D figures/data • plot points on a number line and a coordinate plane • describe, represent, and compare rates of change using graphs in meaningful contexts (i.e. cost per unit, miles per hour, wages, batting averages) and in discrete (i.e. cost per unit) and continuous (distance per unit of time) settings
Standard #3: Analyze functional relationships to explain how a change in one quantity results in a change in another.	Objectives: Students... • use iteration as a tool for describing and analyzing functional relationships; represent on a graphing calculator • investigate and describe the effect of a change in one number on another
Standard #4: Use patterns and functions to represent and solve problems.	Objectives: Students... • use patterns and functions to solve problems • use patterns involving integers and positive rational numbers to solve problems

Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Understand and apply the concepts of variable, expressions, and equation.	Objectives: Students... • use expressions with variables (i.e. letters, shapes) to develop an understanding of and to describe algebraic relationships, mappings, formulas, expressions, equations, and inequalities

Algebra (continued)

Standard #2: Represent situations and number patterns with tables, graphs, verbal rules, and equations, and explore the interrelationships of these representation.	Objectives: Students... • use and analyze tables and graphs to identify algebraic relationships • represent number patterns with verbal and written rules and standard algebraic notations; describe the properties and relationships
Standard #3: Analyze tables and graphs to identify properties and relationships.	Objectives: Students... • use tables and graphs to identify and describe properties and relationships • develop and describe the concept of proportional relationships between quantities using lines through the origin
Standard #4: Demonstrate an ability to solve linear equations using concrete, informal, and formal methods.	Objectives: Students... • use calculators, computers, concrete manipulatives (i.e. Algebra Lab Gear), and real-life situations to explore/describe linear relationships and to solve simple linear equations • represent real-life situations to solve linear equations (i.e. ratio and proportion: wrist is half neck size; 4 prime numbers < 10; $C = 15n$ for cost of n items @ \$.15 each)
Standard #5: Describe the strategies used to explore inequalities and nonlinear equations.	Objectives: Students... • use verbal and written means of describing strategies concerning inequalities and nonlinear equations
Standard #6: Apply algebraic methods to solve a variety of real-world and theoretical problems.	Objectives: Students... • manipulate and use algebraic expressions to solve meaningful problems • develop algebraic ideas of patterns and relationships in all areas of mathematics
Standard #7: Construct expressions or equations that model problems.	Objectives: Students... • form and manipulate equations or inequalities to solve problems
Standard #8: Explore and describe a variety of ways to solve equations: include hands-on activities, trial and error, and numerical analysis.	Objectives: Students... • use multiple strategies and tools to solve equations
Standard #9: Know and apply algebraic procedures for solving equations and inequalities.	Objectives: Students... • use algebraic procedures and strategies to solve real-world and mathematical problems using equations and inequalities

Strand #3: Geometry and Measurement

Geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretation can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Identify, describe, compare, and classify geometric figures.	Objectives: Students... • identify, describe, compare, and classify properties of shapes including different types of triangles (scalene, isosceles, right), quadrilaterals, and other polygons • identify point and line symmetry in given polygons • identify, describe, compare, and classify 2-D shapes and 3-D geometric figures • explore, identify, describe spatial relationships and properties of 2-D shapes and 3-D figures using manipulatives and technology
Standard #2: Explore and describe the properties of points, lines, and planes.	Objectives: Students... • measure, describe, classify, and construct angles: acute, obtuse, right, straight, complementary, and supplementary
Standard #3: Visualize and represent (ie build, draw) geometric figures.	Objectives: Students... • identify, name, and construct plane and simple solid figures • identify, describe, and draw congruent and similar figures
Standard #4: Explore and describe transformations of geometric figures.	Objectives: Students... • identify/describe transformations of reflections, translations, slides, flips, and rotations • tessellate shapes across a plane • apply and describe frieze and strip patterns
Standard #5: Represent and solve problems using geometric models.	Objectives: Students... • relate geometric shapes and ideas to the environment, number, and measurement
Standard #6: Understand and apply geometric properties and relationships.	Objectives: Students... • apply the comparison of similar figures and the ratio of their corresponding lengths and areas to solve problems • apply proportional relationships to solve problems

Geometry (continued)

Standard #7: Develop and explain the concept of Pi.	Objectives: Students... • measure the circumferences and diameters of at least five different circular objects and explain how the ratios approach Pi.
Standard #8: Develop and explain the concept of the Pythagorean Theorem.	Objectives: Students... • explore and describe the Pythagorean Theorem using concrete materials (i.e. tangrams, rods, etc.)

Measurement: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Estimate, make, and use measurements to describe and compare phenomena.	Objectives: Students... • describe and use estimates and actual measurements in real-life situations
Standard #2: Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.	Objectives: Students... • select and use appropriate units and tools of measure
Standard #3: Understand the process, structure, and use of systems of measurement.	Objectives: Students... • use measurement ideas in association with the handling of data, shapes, and space and to solve mathematical problems
Standard #4: Describe the meaning of and use perimeter, area, volume, angle measure, capacity, density, weight, and mass as forms of measurement.	Objectives: Students... • describe the meaning of and calculate the area of a rectangle and a triangle; the volume of a cube and a box; and the perimeter of triangles, rectangles, and other simple polygons
Standard #5: Develop, describe, and use the concepts of rates and other derived and indirect measurements.	Objectives: Students... • understand and use maps and scale drawings
Standard #6: Develop and apply formulas and procedures for determining measures to solve problems .	Objectives: Students... • develop and apply formulas for area, perimeter, and volume for standard figures, objects, and for figures derived from combinations of known figures (i.e. a figure made by combining a rectangle and circle)

Strand #4: Probability, Statistics, and Discrete Math

By including statistics (and probability) in the sixth grade curriculum, students review many mathematical ideas, relate mathematics to the real world, and extend their ideas about statistics (and probability). (NCTM Standards)

Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Collect, organize, and describe data systematically.	Objectives: Students... • collect, organize, display, and describe information and data in many forms
Standard #2: Construct, read, and interpret tables, charts, and graphs.	Objectives: Students... • simulate, display, graph, and analyze data using multiple representations such as technology, tables, charts, and graphs • construct and interpret line plots, stem and leaf plots, and frequency distributions
Standard #3: Make inferences and convincing arguments that are based on data analysis.	Objectives: Students... • use the "best line through data" concept to make predictions and to solve problems
Standard #4: Evaluate arguments that are based on data analysis.	Objectives: Students... • evaluate arguments that are based on data analysis
Standard #5: Develop and explain why statistical methods are powerful aids for decision making.	Objectives: Students... • find and describe the mean, median, and mode of data • read and interpret statistical data to make predictions, inferences, and decisions

Probability: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Model situations by devising and carrying out experiments or simulations to determine probabilities.	Objectives: Students... • carry out probability experiments; discuss the results
Standard #2: Construct a sample space to determine probabilities.	Objectives: Students... • determine probabilities of real-world situations such as weather, sports, etc.

Probability (continued)

Standard #3: Describe the power of using a probability model by comparing experimental results with mathematical expectations.	Objectives: Students... • conduct experiments to determine experimental probability and construct a table to establish the theoretical probability and compare the two results
Standard #4: Make predictions that are based on experimental or theoretical probabilities, and determine their reasonableness.	Objectives: Students... • solve problems using probability methods; make and analyze predictions in relation to their reasonableness
Standard #5: Develop and explain an appreciation for the pervasive use of probability in the real world.	Objectives: Students... • cite at least five real-world situations and show how probability is used in each

Discrete Math:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Explore discrete mathematics concepts.	Objectives: Students... • represent data in an organized fashion so that the number of items in a set can be determined • recognize, describe, extend, and create a wide variety of sequences
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BPS Learning Standards: Seventh Grade Mathematics

Strand #1: Number Sense

Number sense refers to an intuitive feeling for numbers and their various uses and interpretations; an appreciation for various levels of accuracy when figuring; the ability to detect arithmetical errors; and a common sense approach to using numbers. (NCTM Standards)

Number Sense and Number Relationships:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand, represent, and use equivalent forms of numbers (integers, fractions, decimals, percents, exponents, and scientific notation) in the real world and in problem solving situations.	Objectives: Students will... • identify and use place value in exponential, standard, and expanded form (including negative, positive, and zero powers) and apply them in meaningful problem solving situations • apply the knowledge of scientific notation
Standard #2: Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students will... • continue to reinforce computations with fractions (decimals, percent, ratio and proportion) and real numbers (integers, rationals, irrationals) • continue to recognize, compare, order and graph integers and rational numbers on a number line; locate a number between two given numbers • find the absolute value of a number
Standard #3: Understand and apply ratios, proportions, and percents.	Objectives: Students will... • understand and apply ratio and proportion to probability and geometry to solve numerical and algebraic problems
Standard #4: Investigate and describe the relationship among fractions, decimals, and percents.	Objectives: Students will... • continue to investigate and describe the relationship among fractions, decimals, and percents
Standard #5: Represent numerical relationships in one- and two-dimensional graphs.	Objectives: Students will... • use a graphing calculator to graph ordered pairs and convert numerical patterns from tables to graph form

Number Sense, Computation, and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Compute with whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students will... • understand, use and perform four fundamental arithmetic operations on whole numbers, fractions, decimals, percents and integers; use order of operations
Standard #2: Develop, analyze, and explain procedures for computation and techniques for estimation.	Objectives: Students will... • develop and describe multiple strategies for estimating quantities • estimate the outcome of operations on whole numbers, fractions, decimals and percents and scientific notation
Standard #3: Develop, analyze, and explain procedures for solving proportions.	Objectives: Students will... • recognize and use ratio and proportion in practical situations
Standard #4: Select and use an appropriate method for computing from among mental arithmetic, paper and pencil, calculator, and computer methods.	Objectives: Students will... • use a variety of approaches for computing and solving problems (including the graphing calculator) • write number stories involving various operations in the context of measurement, geometry, probability, and statistics
Standard #5: Use computation, estimation, and proportions to solve problems.	Objectives: Students will... • use estimation to solve problems involving money, length, area, perimeter, and volume
Standard #6: Estimate to check the reasonableness of results.	Objectives: Students will... • apply a variety of methods to check reasonableness of results

Number Systems and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and explain the need for numbers other than whole numbers.	Objectives: Students... • create and solve meaningful problems that require the use of numbers other than whole numbers
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Number Systems and Number Theory (continued)

Standard #2: Know and use order relations for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... differentiate between types of numbers (whole and real numbers, integers, rationals and irrationals)
Standard #3: Use operations involving fractions, decimals, integers, and rational numbers.	Objectives: Students... use operations involving fractions, decimals, and integers and rational numbers
Standard #4: Demonstrate how basic operations are related to one another.	Objectives: Students... - continue to identify and describe the equivalent representation of procedures (i.e. demonstrate and describe the relationship of addition for whole numbers, fractions, decimals) - continue to use concrete and abstract models to understand and describe the mathematical processes underlying the operations of addition, subtraction, multiplication, and division (and their relationship with one another) on fractions, decimals, and integers
Standard #5: Create and apply number theory concepts, including prime numbers, factors, and multiples.	Objectives: Students... - find and use common multiples, factors, prime and composite numbers - use divisibility tests (2,3,4,5,6,8,9,10,11 and their multiples)

Strand #2: Patterns, Relations, and Functions

Mathematicians observe patterns; they conjecture, test, discuss, verbalize, and generalize these patterns. Through this process, they discover the salient features of the pattern, construct understanding of concepts and relationships, develop a language to talk about the pattern, integrate and discriminate between the pattern and other patterns. When relationships between quantities in a pattern are studied, knowledge about important mathematical relationships and functions emerges. (NCTM Standards)

Patterns and Functions: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, extend, analyze, and create a wide variety of patterns.	Objectives: Students... - describe and develop patterns using numbers, variables, and geometric figures - develop patterns into algebraic forms (functions, relations, general term)

Patterns and Functions (continued)

Standard #2: Describe and represent relationships with models, tables, graphs, and rules; use sentences and algebraic expressions.	Objectives: Students... • describe and represent patterns using models, tables, graphs, simple rules, and manipulatives such as Algebra Lab Gear
Standard #3: Analyze functional relationships to explain how a change in one quantity results in a change in another.	Objectives: Students... • develop and apply the idea of a function as a certain sort of relationship between quantities
Standard #4: Use patterns and functions to represent and solve problems.	Objectives: Students... • use patterns and functions to solve problems • use patterns involving integers and positive rational numbers to solve problems

Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Understand and apply the concepts of variable, expressions, and equation.	Objectives: Students... • develop and apply key concepts such as variable, equivalence, order, and inverse in the context of number, algebra, and geometry; use order of operations on algebraic expressions
Standard #2: Represent situations and number patterns with tables, graphs, verbal rules, and equations, and explore the interrelationships of these representations.	Objectives: Students... • use and analyze tables and graphs to identify algebraic relationships • represent number patterns with verbal and written rules and standard algebraic notations: describe the properties and relationships • use and find a function rule from a table of data, graphs and rules
Standard #3: Analyze tables and graphs to identify properties and relationships.	Objectives: Students... • use tables and graphs to apply the properties of addition, subtraction, multiplication, and division

Algebra (continued)

Standard #4: Demonstrate an ability to solve linear equations using concrete, informal, and formal methods.	Objectives: Students... • use calculators, computers, concrete manipulatives (i.e. Algebra Lab Gear), and real-life situations to explore and describe linear relationships and to solve simple linear equations • represent real-life situations to solve linear equations • develop an understanding of how algebra is used in the real world (e.g., as it relates to ratio and proportion)
Standard #5: Describe the strategies used to explore inequalities and nonlinear equations.	Objectives: Students... • solve and graph solutions of inequalities
Standard #6: Apply algebraic methods to solve a variety of real-world and theoretical problems.	Objectives: Students... • understand and use proportional reasoning in real-life situations such as: scale drawing, rate and speed • recognize and write in exponential notation • recognize and use the commutative, associative, distributive properties of addition and multiplication in abstract algebra form
Standard #7: Construct expressions or equations that model problems.	Objectives: Students... • form and manipulate equations or inequalities to solve problems involving geometry, probability, and statistics
Standard #8: Explore and describe a variety of ways to solve equations: include hands-on activities, trial and error, and numerical analysis.	Objectives: Students... • use multiple strategies and tools to solve equations
Standard #9: Know and apply algebraic procedures for solving equations and inequalities.	Objectives: Students... • apply algebraic procedures for solving equations and inequalities

Strand #3: Geometry and Measurement

The study of geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretation can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Identify, describe, compare, and classify geometric figures.	Objectives: Students... • identify and draw the basic geometric figures (point, line, plane, intersect, line segment, endpoint, ray, and angles, vertex of an angle and side of an angle)
Standard #2: Explore and describe the properties of points, lines, and planes.	Objectives: Students... • identify and draw parallel, perpendicular, and transversal lines, and explore the relationships between the angles formed by these lines • identify, draw, and describe line segments, rays, angles using letters and measuring angles with a protractor
Standard #3: Visualize and represent (i.e. build, draw) geometric figures.	Objectives: Students... • classify and draw polygons and circles (center, diameter, perimeter) • identify solid shapes (measure to quarter units and one tenth units)
Standard #4: Explore and describe transformations of geometric figures.	Objectives: Students... • continue to explore, identify and use transformations such as flips, turns, rotations, translations, (e.g., wall paper patterns) and composite transformations
Standard #5: Represent and solve problems using geometric models.	Objectives: Students... • relate geometric shapes and ideas to the measurement, ratio and proportion
Standard #6: Understand and apply geometric properties and relationships.	Objectives: Students... • recognize and draw symmetric, similar and congruent figures and solve problems using similarity of figures
Standard #7: Develop and explain the concept of Pi (Π).	Objectives: Students... • measure the circumferences and diameters of at least five different circular objects and explain how the ratios approach Pi.

Geometry (continued)

Standard #8: Develop and explain the concept of the Pythagorean Theorem.	Objectives: Students... • know, understand, and apply the Theorem
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Measurement: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Estimate, make, and use measurements to describe and compare phenomena.	Objectives: Students... • describe and use estimates and actual measurements in real-life situations
Standard #2: Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.	Objectives: Students... • choose appropriate units of measurement and apply the concept of accuracy (significant level) at predetermined levels
Standard #3: Understand the process, structure, and use of systems of measurement.	Objectives: Students... • understand the process and relate measurement to number, data, and geometry
Standard #4: Describe the meaning of and use perimeter, area, volume, angle measure, capacity, density, weight, and mass as forms of measurement.	Objectives: Students... • identify and calculate the area of a rectangle and triangle, volume of a cube, and a box • find the perimeter of simple figures (triangle, rectangle, and polygons) • use customary and metric units for length (meter, decimeter, centimeter), mass and capacity • use powers of ten to metric measurement and scientific notation • identify, name and classify 2-dimensional geometric figures and shapes
Standard #5: Develop, describe, and use the concepts of rates and other derived and indirect measurements.	Objectives: Students... • use computations with elapsed time (e.g., hours worked from a given time to another given time, etc.) and conversions from one unit of time to another
Standard #6: Develop and apply formulas and procedures for determining measures to solve problems.	Objectives: Students... • develop and apply formulas for area (including surface area), perimeter, and volume for standard figures, objects, and for figures derived from combinations of known figures, both 2D and 3D (i.e. a figure made by combining a rectangle and circle)

Strand #4: Probability, Statistics, and Discrete Math

When students gather their own data, they become intimately familiar with the information, they develop an understanding of what it really means to organize and summarize data. When students draw conclusions based on their experiences, they develop the skills needed to become critical consumers of someone else's data summaries and analyses. Only through personal experiences with the whole process can students develop critical thinking skills to question, analyze, and interpret data from outside sources. (NCTM Standards)

Statistics:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Collect, organize, and describe data systematically.	Objectives: Students... • collect, organize, display, and describe information and data in many forms
Standard #2: Construct, read, and interpret tables, charts, and graphs.	Objectives: Students... • simulate, display, graph, and analyze data using multiple representations such as technology, tables, charts, and graphs • construct and interpret line plots, stem and leaf plots, and frequency distributions
Standard #3: Make inferences and convincing arguments that are based on data analysis.	Objectives: Students... • analyze survey data to make predictions and to solve problems
Standard #4: Evaluate arguments that are based on data analysis.	Objectives: Students... • evaluate arguments that are based on data analysis
Standard #5: Develop and explain why statistical methods are powerful aids for decision making.	Objectives: Students... • calculate and describe mean, median, mode and range • read and interpret statistical data to make predictions, inferences, and decisions

Probability:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Model situations by devising and carrying out experiments or simulations to determine probabilities.	Objectives: Students... • carry out probability experiments; discuss the results
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Probability (continued)

Standard #2: Construct a sample space to determine probabilities.	Objectives: Students... • determine the probabilities of real-world situations such as weather, sports, etc.
Standard #3: Describe the power of using a probability model by comparing experimental results with mathematical expectations.	Objectives: Students... • conduct experiments to determine experimental probabilities and construct a table to establish theoretical probabilities, and compare the two results
Standard #4: Make predictions that are based on experimental or theoretical probabilities, and determine their reasonableness.	Objectives: Students... • solve problems using probability methods; make and analyze predictions in relation to their reasonableness
Standard #5: Develop and explain an appreciation for the pervasive use of probability in the real world.	Objectives: Students... • cite at least five real-world situations and show how probability is used in each

Discrete Math:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Explore discrete mathematics concepts.	Objectives: Students... • create and use Venn diagrams to solve problems • create simple algorithms to solve problems • use counting techniques (tree diagram, permutation and combination techniques) to determine the number of outcomes for situations • investigate the benefits of simple circuits and networks (paper routes, mail delivery) • use logic and inductive reasoning to make predictions related to a series of statements
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BPS Learning Standards: Eighth Grade Mathematics

Strand #1: Number Sense

Number sense refers to an intuitive feeling for numbers and their various uses and interpretations; an appreciation for various levels of accuracy when figuring; the ability to detect arithmetical errors; and a common sense approach to using numbers. (NCTM Standards)

Number Sense and Number Relationships:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand, represent, and use equivalent forms of numbers (integers, fractions, decimals, percents, exponents, and scientific notation) in the real world and in problem solving situations.	Objectives: Students... • reinforce place value with respect to whole numbers and decimals • relate this to computation, metric system, exponential form and scientific notation
Standard #2: Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • master computations with fractions (decimals, percent, ratio and proportion) and real numbers (integers, rationals, irrationals) • understand the effects of operations, e.g. squaring, multiplying and dividing by numbers between 0 and 1
Standard #3: Understand and apply ratios, proportions, and percents.	Objectives: Students... • understand and apply ratio and proportion to probability and geometry to solve numerical problems
Standard #4: Investigate and describe the relationship among fractions, decimals, and percents.	Objectives: Students... • continue to investigate and describe the relationship among fractions, decimals, and percents
Standard #5: Represent numerical relationships in one- and two-dimensional graphs.	Objectives: Students... • use a graphing calculator to graph ordered pairs and convert numerical patterns from tables to graph form

Number Sense, Computation, and Estimation

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Compute with whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • master the laws of exponents (integer and rational)
Standard #2: Develop, analyze, and explain procedures for computation and techniques for estimation.	Objectives: Students... • use estimation technique and inverse operations to confirm results
Standard #3: Develop, analyze, and explain procedures for solving proportions.	Objectives: Students... • recognize and use ratio and proportion
Standard #4: Select and use an appropriate method for computing from among mental arithmetic, paper and pencil, calculator, and computer methods.	Objectives: Students... • use a variety of approaches for computing and solving problems (including the graphing calculator)
Standard #5: Use computation, estimation, and proportions to solve problems.	Objectives: Students... • use estimation to solve problems involving money, length, area, perimeter, and volume
Standard #6: Estimate to check the reasonableness of results.	Objectives: Students... • apply a variety of methods to check reasonableness of results

Number Systems and Number Theory:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Understand and explain the need for numbers other than whole numbers.	Objectives: Students... • create and solve problems that require the use of numbers other than whole numbers in the context of geometry, probability, and statistics
Standard #2: Know and use order relations for whole numbers, fractions, decimals, integers, and rational numbers.	Objectives: Students... • master the types of numbers (whole and real numbers, integers, rationals and irrationals)
Standard #3: Use operations involving fractions, decimals, integers, and rational numbers.	Objectives: Students... • master operations involving fractions, decimals, integers, rational, and irrational numbers

Number Systems and Number Theory (continued)

Standard #4: Demonstrate how basic operations are related to one another.	Objectives: Students... • master equivalent representation of procedures (i.e. demonstrate and describe the relationship of addition for whole numbers, fractions, decimals) • use concrete and abstract models to understand and describe the mathematical processes underlying the operations of addition, subtraction, multiplication, and division (and their relationship with one another) on fractions, decimals, and integers
Standard #5: Create and apply number theory concepts, including prime numbers, factors, and multiples.	Objectives: Students... • master the laws of exponents (integer and rational) • master the use primes and properties of numbers such as GCM and LCM to compute and/or approximate powers and roots

Strand #2: Patterns, Relations, and Functions

One of the central themes of mathematics is the study of patterns and functions. This study requires students to recognize, describe, and generalize patterns and build mathematical models to predict the behavior of real-world phenomena that exhibit the observed pattern. (NCTM Standards)

Patterns and Functions: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Describe, extend, analyze, and create a wide variety of patterns.	Objectives: Students... • explore number patterns; generate rules for number sequences; • use graphing calculator to express the data in tabular, symbolic and graphic form
Standard #2: Describe and represent relationships with models, tables, graphs, and rules; use sentences and algebraic expressions.	Objectives: Students... • continue to describe and represent patterns using models, tables, graphs, simple rules, and manipulatives such as Algebra Lab Gear
Standard #3: Analyze functional relationships to explain how a change in one quantity results in a change in another.	Objectives: Students... • develop and apply the idea of a function as a certain sort of relationship between quantities
Standard #4: Use patterns and functions to represent and solve problems.	Objectives: Students... • develop and apply the concept of function through the linear and quadratic levels

Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Understand and apply the concepts of variable, expressions, and equation .	Objectives: Students... • continue to develop and apply key concepts such as variable, equivalence, order, and inverse in the context of number, algebra, and geometry
Standard #2: Represent situations and number patterns with tables, graphs, verbal rules, and equations, and explore the interrelationships of these representations.	Objectives: Students... • continue to use the graphing calculator to generate tables and graphs and identify algebraic relationships • explore number patterns; generate rules for number sequences
Standard #3: Analyze tables and graphs to identify properties and relationships.	Objectives: Students... • continue to use tables and graphs to identify and describe properties and relationships
Standard #4: Demonstrate an ability to solve linear equations using concrete, informal, and formal methods.	Objectives: Students... • continue to use calculators, computers, concrete manipulatives (i.e. Algebra Lab Gear), and real-life situations to explore and describe linear relationships and to solve simple linear equations • represent real-life situations to solve linear and square functions • explore the modification to a given function which causes it to stretch, shrink, shift and/or translate
Standard #5: Describe the strategies used to explore inequalities and nonlinear equations.	Objectives: Students... • master the attributes of linear equations and inequalities, absolute value, and quadratic equations
Standard #6: Apply algebraic methods to solve a variety of real-world and theoretical problems.	Objectives: Students... • develop and apply algebraic ideas of patterns, relationships, and functions in all areas of mathematics
Standard #7: Construct expressions or equations that model problems.	Objectives: Students... • construct, interpret and evaluate formulas and expressions drawn from real-life and other academic domains

Algebra (continued)

Standard #8: Explore and describe a variety of ways to solve equations: include hands-on activities, trial and error, and numerical analysis.	Objectives: Students... • use multiple strategies and tools to solve equations
Standard #9: Know and apply algebraic procedures for solving equations and inequalities.	Objectives: Students... • apply algebraic procedures for solving equations and inequalities

Strand #3: Geometry and Measurement

The study of geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretations can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Identify, describe, compare, and classify geometric figures.	Objectives: Students... • master the basic geometric figures • continue to classify polygons
Standard #2: Explore and describe the properties of points, lines, and planes.	Objectives: Students... • master selected properties
Standard #3: Visualize and represent (i.e. build, draw) geometric figures.	Objectives: Students... • master the use of sine, cosine, tangent ratios to solve right triangles
Standard #4: Explore and describe transformations of geometric figures.	Objectives: Students... • use in combination the transformation of translation, reflection, rotation and dilation • define similarity and congruence in terms of transformation
Standard #5: Represent and solve problems using geometric models.	Objectives: Students... • relate geometric shapes and ideas to the measurement, ratio and proportion
Standard #6: Understand and apply geometric properties and relationships.	Objectives: Students... • recognize and draw symmetric, similar and congruent figures and solve problems using similarity of figures

Geometry (continued)

Standard #7: Develop and explain the concept of Pi (Π).	Objectives: Students... • measure the circumference and diameter of at least five different circular objects and explain how the ratios approach Pi.
Standard #8: Develop and explain the concept of the Pythagorean Theorem.	Objectives: Students... • know, understand and apply the Pythagorean Theorem

Measurement:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Estimate, make, and use measurements to describe and compare phenomena.	Objectives: Students... • master the reading and the interpretation of scales and the degree of accuracy that is appropriate
Standard #2: Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.	Objectives: Students... • master the appropriate units of measurement and apply the concept of accuracy (significant level) at predetermined levels
Standard #3: Understand the process, structure, and use of systems of measurement.	Objectives: Students... • understand the process and relate measurement to number, data, and geometry
Standard #4: describe the meaning of and use perimeter, area, volume, angle measure, capacity, density, weight, and mass as forms of measurement.	Objectives: Students... • master the formulas for the perimeter, surface area, and/or volumes of common geometric shapes • utilize the number of dimensions in a shape to determine appropriate formulas
Standard #5: Develop, describe, and use the concepts of rates and other derived and indirect measurements.	Objectives: Students... • understand and use compound measures, including speed and density
Standard #6: Develop and apply formulas and procedures for determining measures to solve problems.	Objectives: Students... • apply formulas for the perimeter, surface area, and/or volumes of common geometric shapes

Strand #4: Probability, Statistics, and Discrete Math

An understanding of probability and the related area of statistics is essential to being an informed citizen. Students in middle grades have an intense interest in the notions of fairness and the chances of winning games. The study of probability develops concepts and methods for investigating such situations. (NCTM Standards)

Statistics: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Collect, organize, and describe data systematically.	Objectives: Students... • collect, organize, display, and describe information and data in many forms
Standard #2: Construct, read, and interpret tables, charts, and graphs.	Objectives: Students... • design and use data collection sheets; access information from reference sources; where appropriate, use graphing calculators to create frequency tables
Standard #3: Make inferences and convincing arguments that are based on data analysis.	Objectives: Students... • design a questionnaire or an experiment to capture needed to follow lines of inquiry and to test hypothesis
Standard #4: Evaluate arguments that are based on data analysis.	Objectives: Students... • evaluate arguments that are based on data analysis
Standard #5: Develop and explain why statistical methods are powerful aids for decision making.	Objectives: Students... • calculate, estimate and use appropriate measures of central tendency, i.e., mode, median, and mean with discrete data • read and interpret statistical data to make predictions, inferences, and decisions

Probability: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Model situations by devising and carrying out experiments or simulations to determine probabilities.	Objectives: Students... • carry out probability experiments; discuss the results
Standard #2: Construct a sample space to determine probabilities.	Objectives: Students... • determine probabilities of real-world situations such as weather, sports, etc.

Probability (continued)

Standard #3: Describe the power of using a probability model by comparing experimental results with mathematical expectations.	Objectives: Students... • identify the outcomes of a two experiment combinations; use tabulations and/or tree diagrams to represent the events; learn the calculation methods that involve tree diagram, permutation and combination
Standard #4: Make predictions that are based on experimental or theoretical probabilities, and determine their reasonableness.	Objectives: Students... • solve problems using probability methods; make and analyze predictions in relation to their reasonableness
Standard #5: Develop and explain an appreciation for the pervasive use of probability in the real world.	Objectives: Students... • cite at least five real-world situations and show how probability is used in each.

Discrete Math:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #2: Explore discrete mathematics concepts.	Objectives: Students... • investigate and describe the mathematical properties of sets and systems that have a countable number of elements • create and use Venn diagrams to solve problems • create simple algorithms to solve problems • use counting techniques, tree diagrams, permutations and combination techniques • investigate the benefits of simple circuits and networks (e.g., paper routes, mail delivery) • use logic and inductive reasoning to make predictions related to a series of statements
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Introductory Note: High School Mathematics Sequence

The standards for high school mathematics included on the following pages are presented in two sequences (which are represented by Students #1 and #2 in the chart below). If a student elects the first sequence, s/he would complete Calculus by the close of twelfth grade. If a student elected the second sequence, s/he would complete our Integrated Mathematics curriculum by the close of the twelfth grade.

The third student in the chart represents a student who elected the 9-12 Integrated Math sequence, but decided to accelerated his or her program after s/he'd completed Integrated Math 1A&B in the tenth grade. This student went on to complete Pre-Calculus by the time s/he graduated.

The fourth student in the chart elected the accelerated sequence, only to find that s/he needed more time to master the concepts in the curriculum. This student shifted to the 9-12 Integrated Math sequence and finished the sequence by the close of twelfth grade.

In all cases, the students (and their parents) have the opportunity to elect the sequence they'd like to tackle. In addition, at different points during their high school years, they all have opportunities to accelerated or decelerate their pace.

The standards for Pre-Calculus, Calculus, and Discrete Mathematics have not yet been developed. All of the standards for Integrated Math are included in this document.

One final note on the document. At this point in the process, all of the standards are presented in narrative form. During the coming year, we expect to complement the narrative with examples of problems students will be required to solve at each grade level, and teaching vignettes that will give teachers a snap-shot of exemplary lessons and practices.

High School Math: Student Scenarios (examples)

	9th Grade	10th Grade	11th Grade	12th Grade
Student #1	Integrated Mathematics Course 1A&B	Integrated Mathematics Course 2A&B	Pre-Calculus	Calculus or Discrete Math
Student #2	Integrated Mathematics Course 1A	Integrated Mathematics Course 1B	Integrated Mathematics Course 2A	Integrated Mathematics Course 2B
Student #3	Integrated Mathematics Course 1A	Integrated Mathematics Course 1B	Integrated Mathematics Course 2A&B	Pre-Calculus
Student #4	Integrated Mathematics Course 1A&B	Integrated Mathematics Course 1B	Integrated Mathematics Course 2A	Integrated Mathematics Course 2B

BPS Learning Standards: Integrated Mathematics 1A&B

Strand #1: Number Sense

Number sense refers to an intuitive feeling for numbers and their various uses and interpretations; an appreciation for various levels of accuracy when figuring; the ability to detect arithmetical errors; and a common sense approach to using numbers. (NCTM Standards)

Number Sense and Number Relationships:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Compare and contrast the real number system and its various subsystems with regard to their structural characteristics.	Objectives: Students... • distinguish between rational and irrational numbers. • conduct, model, recognize, compare and order rational and irrational numbers. • appreciate that irrational numbers complete the real number system. • recognize when and how to apply the field properties in problems using real numbers.
Standard #2: Develop the complex number system and demonstrate facility with its operations.	Objectives: Students... • appreciate the need to extend the real number system to complex number system through investigation of problems. • use a coordinate system to locate complex numbers. • investigate (or appreciate) what is gained, what is lost and what is retained in moving from real-number system to the complex number system.
Standard #3: Understand the logic of algebraic procedures and their interrelationship with geometric ideas and concepts.	Objectives: Students... • use transformations to explore the concept of vectors.
Standard #4: Understand the basic concepts of real and complex numbers.	Objectives: Students... • construct, model, recognize, compare, and order real numbers. • understand/use radical, exponential, and logarithmic expressions in appropriate settings.
Standard #5: Appreciate that seemingly different mathematical systems may be essentially the same.	Objectives: Students... • investigate examples of systems used in various disciplines, e.g., designing electrical circuits (series/parallel), searching electronic databases (and/or), using binary operations ($\times$ & $+$)

Number Sense and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Use estimation strategies to judge the reasonableness of results of computation and problem solving involving real and complex numbers.

Objectives: Students...

- use logical reasoning, as well as estimation and mental computations, to determine the validity of a solution in algebraic, geometrical, and statistical problems.

Standard #2: Use estimation when making and interpreting graphs.

Objectives: Students...

- use scatter plots of sets of data points to graph best-fitting lines.

Number Sense, Computation, and Operations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop operation sense for real and complex numbers.

Objectives: Students...

- use manipulatives, diagrams, and graphs to solve computational problems with rational, irrational, and complex numbers.
- understand and demonstrate algebraically and graphically the relationship between operations and their inverses, including exponential and logarithmic.
- understand the appropriate use of graphing calculators to solve problems involving real and complex numbers.
- understand and calculate the upper and lower bounds of numerical solutions of algebraic problems, particularly in the context of measurement and statistics.
- solve problems involving absolute values.

Standard #2: Relate the mathematical language and symbolism of operations to problem situations

Objectives: Students...

- pose and solve problems using operations on whole numbers, integers, rational, irrational, and complex numbers.
- apply the process of mathematical modeling to real world problem situations.

Strand #2: Patterns, Relations, and Functions

Mathematics is an exploratory science that seeks to understand every kind of pattern that occurs in nature, patterns invented by the human mind, and even patterns created by other patterns. (*On the Shoulder of Giants*, Lynn Arthur Steen)

Relation Functions:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Describe, extend, analyze, and create a wide variety of patterns.	Objectives: Students... • examine numeric and geometric patterns found in nature, mathematics, different cultures, and historical periods. • use inductive reasoning to make generalizations from an observed pattern. • use inductive and indirect methods to pose and prove theorems. • collect and graph data (using graphing calculators and/ or computers when appropriate), and express relationships between variables, both verbally and symbolically. • explore situations involving linear, quadratic, polynomial, trigonometric, exponential, logarithmic, and rational functions as well as piecewise defined functions and relationships that are not functions at all. • use polynomial, rational, trigonometric, exponential, and logarithmic functions to model real world phenomena. • understand and appreciate that a variety of phenomena can be modeled by the same type of function. • predict and express the nth term in arithmetic, geometric, and other (e.g. Fibonacci) sequences, both explicitly and recursively. • explore formulas for finite and infinite sums of series.
Standard #2: Represent and analyze relationships, using tables, verbal rules, equations, and graphs.	Objectives: Students... • translate among tabular, symbolic, and graphical representations of functions.
Standard #3: Model real-world phenomena with a variety of functions.	Objectives: Students... • recognize that a variety of problem situations can be modeled by the same type of function.

Relation Functions (continued)

Standard #4: Analyze the effects of parameter changes on the graphs of functions.	Objectives: Students... • use graphing utilities to observe and predict the behavior of many types of functions, including direct and inverse variation, general polynomial, radical, step, exponential, logarithmic, and trigonometric functions. • associate parameter changes in functions with transformations on a coordinate system. • explore the concept of inverse function informally as the process of undoing the effect of applying a given function. • explore through activities and apply the effect of reflecting the graph of a function across the line $y = x$.
Standard #5: Investigate limiting processes by examining infinite sequences and series.	Objectives: Students... • explore limiting sums for sequences of fractions and repeating decimals.

Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Represent situations that involve variable quantities with expressions, equations, inequalities, and matrices.	Objectives: Students... • model solve problems that involve varying quantities with variables, expressions, inequalities, absolute values, vectors, and matrices. • use matrices as tools for representing data in an organized fashion.
Standard #2: Use tables and graphs as tools to interpret expressions, equations, and inequalities.	Objectives: Students... • use paper and pencil techniques and graphing calculators (or other technology) to represent and analyze graph of expression, equations, and inequalities.

Algebra (continued)

Standard #3: Operate on expressions and matrices, and solve equations and inequalities.	Objectives: Students... • use manipulatives (e.g., algebra tiles) and diagrams to develop procedures for simplifying and operating on expressions (multiplying binomials and factoring trinomials). • explain, use and analyze procedures for operating on algebraic expressions and matrices. • formulate and solve real problems using algebraic expressions and matrices. • use polynomial, rational, trigonometric, exponential functions, and simultaneous linear equations to model real world relationships • solve equations and inequalities from real problems by algebraic and graphical methods. • use a variety of methods for solving equations and inequalities and develop an understanding of appropriate use.
Standard #4: Apply trigonometry to problem situations involving triangles.	Objectives: Students... • use problems from navigation and surveying, (e.g.) to extend understanding of ratios of right triangle trigonometry to angles of any size.
Standard #5: Explore periodic real-world phenomena, using the sine and cosine functions.	Objectives: Students... • develop conceptual understanding of the sine and cosine functions, using graphing calculators. • use graphing utilities to explore the use of sine and cosine functions as mathematical models for such periodic phenomena as uniform circular motion, temperature changes, sound waves, and tide variations.
Standard #6: Apply general graphing techniques to trigonometric functions.	Objectives: Students... • develop an understanding of the properties of trigonometric functions and their inverses. • graph and investigate the behavior of trigonometric functions.

Strand #3: Geometry and Measurement

The study of geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretations can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry and Spatial Sense: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Understand and apply properties involving angles, parallel lines, and perpendicular lines.	Objectives: Students... • explore transformation in terms of rotation, reflection, translations, dilations, congruence, symmetry, and isometric. • explore and use properties of parallel, perpendicular lines, bisectors of angles and segments, triangles and circles through construction.
Standard #2: Interpret and draw three dimensional objects.	Objectives: Students... • analyze properties of three dimensional shapes by constructing models and by drawing and interpreting two dimensional representations of them. • study quadratic and conic sections. • derive equation of a circle, ellipse, parabolas, and hyperbolas and their properties.
Standard #3: Represent problem situations with geometric models and apply properties of figures.	Objectives: Students... • use basic transformations to demonstrate similarity, symmetry, and congruence. • derive distance and midpoint formula in one, two, and three dimensions.
Standard #4: Use induction or deduction to solve problems and to present reasonable explanations of and justifications for the solutions.	Objectives: Students... • deduce properties of, and relationships between, figures from given assumptions. • develop and defend conclusions. • formulate counter examples.
Standard #5: Use transformations, coordinates, and vectors to solve problems.	Objectives: Students... • use basic transformations to demonstrate similarity, symmetry, and congruence of figures. • study, derive, and understand important results in coordinate geometry. • Apply vector, trigonometry, and coordinate geometry methods to the solution of problems related to lines.

Geometry and Spatial Sense (continued)

Standard #6: Interpret algebraic equations and inequalities geometrically and describe geometric objects algebraically.	Objectives: Students... • describe and use transformations in the form of matrices.
Standard #7: Extend, apply, and formalize strategies for determining perimeters, areas, volumes, and surface areas.	Objectives: Students... • use diagrams, models, and other manipulatives to determine methods of finding relationships and measurements of two and three dimensional shapes.
Standard #8: Use trigonometric ratios to solve problems involving indirect measurement.	Objectives: Students... • extend trigonometry to angles of any size, the graphs and behaviors of trigonometric functions. • apply trigonometric properties to the solution of problems in two and three dimensions, including sine and cosine rules.
Standard #9: Solve real-world and mathematical problems using geometric models.	Objectives: Students... • understand the relationship between algebraic and geometric representation of the same mathematical concept.
Standard #10: Analyze patterns produced by processes of geometric change, formally connecting iteration, approximation, limits, self-similarity, and fractional.	Objectives: Students... • use concrete models and diagrams to investigate fractals such as the Serpinski "Triangle"
Standard #11: Use manipulative, computer graphics, graphics software, and other learning tools to demonstrate geometric concepts and connections with other parts of mathematics, science and art.	Objectives: Students... • design and construct geometric patterns (e.g., tessellations) and explore connections with history and art (Islamic tiling, art of M.C. Escher).
Standard #12: Develop geometric interrelations and applications of slope.	Objectives: Students... • design investigations of physical situations involving slope. • use coordinate geometry and slopes to prove lines parallel and perpendicular.

Measurement:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Apply their knowledge of measurement in the construction of a variety of two- and three-dimensional figures.	Objectives: Students... • extend measurement, including distances and angles to more complex plane, shapes, solids. • understand and use relationships between similar figures and solids.
Standard #2: Determine the degree of accuracy of a measurement, for example by understanding and using significant digits.	Objectives: Students... • use compass and straight edge to measure geometric figures to a high degree of accuracy.
Standard #3: Develop and use the concept of indirect measurement, and use techniques of algebra, geometry and trigonometry to measure quantities indirectly.	Objectives: Students... • apply trigonometric methods to practical situations involving triangles and other figures, by using appropriate tools for measurement, developing a geometric model or diagram, and writing and solving corresponding equations.
Standard #4: Use measurement appropriately in other subject areas and career-based contexts	Objectives: Students... • use appropriate measurement tools, along with calculators and computers, to solve problems in science, technology and consumer education, and other areas as well.
Standard #5: Choose appropriate techniques and tools to measure quantities in order to achieve specified degree of precision, accuracy, and tolerance of measurements.	Objectives: Students... • use compass, straight edge manipulatives, and technology to explore geometric constructions and their applications.

Strand #4: Probability, Statistics, and Discrete Math

An understanding of probability and the related area of statistics is essential to being an informed citizen. Students in middle grades have an intense interest in the notions of fairness and the chances of winning games. The study of probability develops concepts and methods for investigating such situations. (NCTM Standards)

Statistics:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Construct, draw inferences, and reason with charts, tables, and graphs that summarize data from real-world situations.	Objectives: Students... • continue to collect, organize, and describe data
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Statistics (continued)

Standard #2: Use sampling and recognize its role in statistical claims.	Objectives: Students... • use sampling methods; consider their reliability • understand and apply the concept of random variables
Standard #3: Design a statistical experiment to study a problem, conduct the experiment, and interpret and communicate the outcomes.	Objectives: Students... • describe the normal curve and use its properties to answer questions about a set of data
Standard #4: Apply measures of central tendency, variability, and correlation.	Objectives: Students... • describe the depression of a set of data • find and interpret the central tendencies, variabilities, distribution, and correlation of sets of data
Standard #5: Transform data to aid in data interpretation and prediction.	Objectives: Students... • use curve fitting to make predictions from data • study the effects of transformation on data in predicting outcomes
Standard #6: Test hypotheses by using appropriate statistics.	Objectives: Students... • analyze the effects of data transformations on measures of central tendencies and variability

Probability:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Use simulations to estimate probabilities.	Objectives: Students... • explore different types of probability distributions
Standard #2: Use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty.	Objectives: Students... • understand when and how to estimate conditional probabilities and apply these methods to solve problems • test hypotheses by using appropriate, predetermined limits of significance
Standard #3: Apply the concept of random variable.	Objectives: Students... • generate and interpret probability distributions including binomial, uniform, normal, and chi-square

Discrete Mathematics:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Represent problem situations using discrete structures such as finite graphs, matrices, sequences, and recurrence relations.

Objectives: Students...

- represent data (points) and solve problem situations using graphs, trees, networks, and matrices.
- make extensive use of Venn (and other) diagrams, along with logical connectives and statements to solve problems from real situations (e.g., economics, finance, sociological.)

Standard #2: Represent and analyze finite graphs using matrices.

Objectives: Students...

- represent networks (e.g., connecting one and two-way streets) with a graph, then use matrices to investigate and interpret possible paths.

Standard #3: Develop and analyze algorithms.

Objectives: Students...

- use algebraic and geometric iteration to explore patterns and solve problems.

Standard #4: Solve numeration and finite probability problems.

Objectives: Students...

- use manipulatives, diagrams, graphs, and technology tools to create and interpret discrete probability distribution.
- use counting principles such as factorial functions, combinations and permutations to solve problems.
- create different discrete probability distributions using technologies whenever appropriate.

Standard #5: Represent and solve problems using linear programming and difference equations.

Objectives: Students...

- explore, using manipulatives and graphs, problems situations involving optimization.
- use algorithms for finding optimal paths and circuits in graphs.
- analyze different algorithms for efficiency in solving optimization problems.

Standard #6: Investigate and describe problem situations that arise in connection with computer validation and the application of algorithms

Objectives: Students...

- investigate and discuss variations which occur when using different algorithms to solve a problem

Discrete Mathematics (continued)

Standard #7: Use inductive and deductive reasoning to investigate problem situations involving networks.	Objectives: Students... • solve network problems (e.g., finding points producing the shortest network), first experimentally, then using geometric constructions and deductive reasoning to validate their findings
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BPS Learning Standards: Integrated Mathematics 2A&B

Strand #1: Number Sense

The focus of the secondary school curriculum remains-as it should-on the transition from concrete to conceptual mathematics. As students' understanding moves from number to variables, from description to proof, from special cases to general equations, they learn the power of mathematical symbols. In a very real sense, the major objective of secondary mathematics is to develop symbol sense. (*Everybody Counts*, NRC)

Number Sense, Numeration, and Mathematical Structure :

Number Sense and Number Relationships:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Compare and contrast the real number system and its various subsystems with regard to their structural characteristics.	Objectives: Students... • recognize when and how to use the field properties in problems using real numbers. • express and simplify numerical expressions involving real numbers. • express real numbers in fractional and radical form as well as in exponential, from using integral and fractional exponents.
Standard #2: Develop the complex number system and demonstrate facility with its operations.	Objectives: Students... • solve problems with complex number solutions, using graphing and algebraic techniques. • using models to analyze and understand subsystems of the complex number system. • use a coordinate system to locate complex numbers.
Standard #3: Understand the logic of algebraic procedures and their interrelationship with geometric ideas and concepts.	Objectives: Students... • use transformations to explore the concept of vectors.
Standard #4: Understand the basic concepts of real and complex numbers.	Objectives: Students... • construct, model, recognize, compare, and order real numbers • understand/use radical, exponential, and logarithmic expressions in appropriate settings.
Standard #5: Appreciate that seemingly different mathematical systems may be essentially the same.	Objectives: Students... • compare subsystems of the real and complex number systems, using a variety of models including physical transformations.

Number Sense and Estimation:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Use estimation strategies to judge the reasonableness of results of computation and problem solving involving real and complex numbers.

Objectives: Students...

- use logical reasoning, as well as estimation and mental computations, to determine the validity of a solution in algebraic, geometrical, and statistical problems.

Standard #2: Use estimation when making and interpreting graphs.

Objectives: Students...

- use scatter plots of sets of data points to graph best-fitting lines.

Number Sense, Computation, and Operations:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Develop operation sense for real and complex numbers.

Objectives: Students...

- use manipulative, diagrams, and graphs to solve computational problems with rational, irrational, and complex numbers.
- understand and demonstrate algebraically and graphically the relationship between operations and their inverses, including exponential and logarithmic.
- understand the appropriate use of graphing calculators to solve problems involving real and complex numbers.
- understand and calculate the upper and lower bounds of numerical solutions of algebraic problems, particularly in the context of measurement and statistics.
- solve problems involving absolute values.

Standard #2: Relate the mathematical language and symbolism of operations to problem situations.

Objectives: Students...

- pose and solve problems using operations on real and complex forms.
- apply the process of mathematical modeling to real world problem situations.

Strand #2: Patterns, Relations, and Functions

Mathematics is an exploratory science that seeks to understand every kind of pattern that occur in nature, patterns invented by the human mind, and even patterns created by other patterns.

(*On the Shoulder of Giants*, Lynn Arthur Steen)

Relation Functions:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Describe, extend, analyze, and create a wide variety of patterns.	Objectives: Students... • examine numeric and geometric patterns found in nature, mathematics, many cultures, and historical periods. • use inductive reasoning to make generalizations from an observed pattern. • use inductive and indirect methods to pose and prove theorems. • collect and graph data (using graphing calculators and/ or computers when appropriate), and express relationship between variables, both verbally and symbolically. • explore situations involving linear, quadratic, polynomial, trigonometric, exponential, logarithmic, and rational functions as well as piece wise defined functions and relationships that are not functions at all. • use polynomial, rational, trigonometric, exponential, and logarithmic functions to model real world phenomena. • understand and appreciate that a variety of a phenomena can be modeled by the same type of function. • predict and express the nth term in arithmetic, geometric, and other (e.g. Fibonacci) sequences, both explicitly and recursively.
Standard #2: Represent and analyze relationships, using tables, verbal rules, equations, and graphs.	Objectives: Students... • translate among tabular, symbolic, and graphical representations of functions.
Standard #3: Model real-world phenomena with a variety of functions.	Objectives: Students... • recognize that a variety of problem situations can be modeled by the same type of function.

Relation Functions (continued)

Standard #4: Analyze the effects of parameter changes on the graphs of functions.	Objectives: Students... • use graphing utilities to observe and predict the behavior of many types of functions, including direct and inverse variation, general polynomial, radical, step, exponential, logarithmic, and trigonometric functions. • associate parameter changes in functions with transformations on a coordinate system. • explore the concept of inverse function informally as the process of undoing the effect of applying a given function. • explore through activities and apply the effect of reflecting the graph of a function across the line $y = x$.
Standard #5: Investigate limiting processes by examining infinite sequences and series.	Objectives: Students... • explore limiting sums for sequences of fractions and repeating decimals.

Algebra: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Represent situations that involve variable quantities with expressions, equations, inequalities, and matrices.	Objectives: Students... • model solve problems that involve varying quantities with variables, expressions, inequalities, absolute values, vectors, and matrices. • use matrices as tools for representing data in an organized fashion.
Standard #2: Use tables and graphs as tools to interpret expressions, equations, and inequalities.	Objectives: Students... • collect, organize, and analyze data from real problems, using graphing calculators and other technology to create tables and graphs. • use sequence feature of graphing calculators to list and graph recursive functions.

Algebra (continued)

Standard #3: Operate on expressions and matrices, and solve equations and inequalities.	Objectives: Students... • use manipulative (e.g., algebra tiles) and diagrams to develop procedures for simplifying and operating on expressions (multiplying binomials and factoring trinomials). • explain, use and analyze procedures for operating on algebraic expressions and matrices. • formulate and solve real problems using algebraic expressions and matrices. • use polynomial, rational, trigonometric, exponential functions, and simultaneous linear equations to model real world relationships.
Standard #4: Apply trigonometry to problem situations involving right triangles.	Objectives: Students... • use problems from navigation and surveying (e.g.) to extend their understanding of ratios of right triangle trigonometry to angles of any size
Standard #5: Explore periodic real-world phenomena, using the sine and cosine functions.	Objectives: Students... • develop conceptual understanding of the sine and cosine functions, using graphing calculators • use graphing utilities to explore the use of sine and cosine functions as mathematical models for such periodic phenomena as uniform circular motion, temperature changes, sound waves, and tide variations
Standard #6: Apply general graphing techniques to trigonometric functions.	Objectives: Students... • develop an understanding of the properties of trigonometric functions and their inverses • graph and investigate the behavior of trigonometric functions

Strand #3: Geometry and Measurement

The study of geometry helps students represent and make sense of the world. Geometric models provide a perspective from which students can analyze and solve problems, and geometric interpretations can help make an abstract (symbolic) representation more easily understood. Many ideas about number and measurement arise from attempts to quantify real-world objects that can be viewed geometrically. (NCTM Standards)

Geometry and Spatial Sense: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #1: Understand and apply properties involving angles, parallel lines, and perpendicular lines.	Objectives: Students... • explore transformation in terms of rotation, reflection, translations, dilations, congruence, symmetry, and isometric. • explore and use properties of parallel, perpendicular lines, bisectors of angles and segments, triangles and circles through construction.
Standard #2: Interpret and draw three dimensional objects.	Objectives: Students... • analyze properties of three dimensional shapes by constructing models and by drawing and interpreting two dimensional representations of them. • study quadratic and conic sections. • derive equation of a circle, ellipse, parabolas, and hyperbolas and their properties.
Standard #3: Represent problem situations with geometric models and apply properties of figures.	Objectives: Students... • use basic transformations to demonstrate similarity, symmetry, and congruence. • derive distance and midpoint formula in one, two, and three dimensions.
Standard #4: Use induction or deduction to solve problems and to present reasonable explanations of and justifications for the solutions.	Objectives: Students... • deduce properties of, and relationships between, figures from given assumptions. • develop and defend conclusions. • formulate counter examples.
Standard #5: Use transformations, coordinates, and vectors to solve problems.	Objectives: Students... • use basic transformations to demonstrate similarity, symmetry, and congruence of figures. • study, derive, and understand important results in coordinate geometry. • Apply vector, trigonometry, and coordinate geometry methods to the solution of problems related to lines.

Geometry and Spatial Sense (continued)

Standard #6: Interpret algebraic equations and inequalities geometrically and describe geometric objects algebraically.	Objectives: Students... • describe and use transformations in the form of matrices.
Standard #7: Extend, apply, and formalize strategies for determining perimeters, areas, volumes, and surface areas.	Objectives: Students... • use diagrams, models, and other manipulatives to determine methods of finding relationships and measurements of two and three dimensional shapes.
Standard #8: Use trigonometric ratios to solve problems involving indirect measurement.	Objectives: Students... • extend trigonometry to angles of any size, the graphs and behaviors of trigonometric functions. • apply trigonometric properties to the solution of problems in two and three dimensions, including sine and cosine rules.
Standard #9: Solve real-world and mathematical problems using geometric models.	Objectives: Students... • understand the relationship between algebraic and geometric representation of the same mathematical concept.
Standard #10: Analyze patterns produced by processes of geometric change, formally connecting iteration, approximation, limits, self-similarity, and fractional.	Objectives: Students... • use manipulatives, diagrams, models and computer software to investigate shapes with fractional dimensions (e.g., fractals)
Standard #11: Use manipulative, computer graphics, graphics software, and other learning tools to demonstrate geometric concepts and connections with other parts of mathematics, science and art.	Objectives: Students... • design and construct geometric patterns in two and three dimensions, and investigate connections with other parts of mathematics, science, art, and other areas
Standard #12: Develop geometric interrelations and applications of slope.	Objectives: Students... • design investigations of physical situations involving slope of linear, quadratic, and higher order functions

Measurement:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Apply their knowledge of measurement in the construction of a variety of two- and three-dimensional figures.	Objectives: Students... • extend measurement, including distances and angles to more complex plane, shapes, solids • understand and use relationships between similar figures and solids
Standard #2: Determine the degree of accuracy of a measurement, for example by understanding and using significant digits.	Objectives: Students... • use compass and straight edge to measure geometric figures to a high degree of accuracy
Standard #3: Develop and use the concept of indirect measurement, and use techniques of algebra, geometry and trigonometry to measure quantities indirectly.	Objectives: Students... • apply trigonometric methods to real problems involving indirect measurement of right and non-right triangles, circles, and other shapes. Use appropriate tools for measurement, develop a geometric model or diagram, and write and solve corresponding equations
Standard #4: Use measurement appropriately in other subject areas and career-based contexts	Objectives: Students... • use appropriate measurement and technology tools to analyze and solve problems from science, technology, and consumer education, as well as other areas
Standard #5: Choose appropriate techniques and tools to measure quantities in order to achieve specified degree of precision, accuracy, and tolerance of measurements.	Objectives: Students... • use compass, straight edge manipulatives and technology to explore geometric constructions and their applications

Strand #4: Probability, Statistics, and Discrete Math

An understanding of probability and the related area of statistics is essential to being an informed citizen. Students in middle grades have an intense interest in the notions of fairness and the chances of winning games. The study of probability develops concepts and methods for investigating such situations. (NCTM Standards)

Statistics:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Construct, draw inferences, and reason with charts, tables, and graphs that summarize data from real-world situations.	Objectives: Students... • continue to collect, organize, and describe data
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Statistics (continued)

Standard #2: Use sampling and recognize its role in statistical claims.	Objectives: Students... • use sampling methods; consider their reliability • understand and apply the concept of random variables
Standard #3: Design a statistical experiment to study a problem, conduct the experiment, and interpret and communicate the outcomes.	Objectives: Students... • describe the normal curve and use its properties to answer questions about a set of data
Standard #4: Apply measures of central tendency, variability, and correlation.	Objectives: Students... • describe the depression of a set of data • find and interpret the central tendencies, variabilities, distribution, and correlation of sets of data
Standard #5: Transform data to aid in data interpretation and prediction.	Objectives: Students... • use curve fitting to make predictions from data • study the effects of transformation on data in predicting outcomes
Standard #6: Test hypotheses by using appropriate statistics.	Objectives: Students... • analyze the effects of data transformations on measures of central tendencies and variability

Probability: Students engage in problem-solving, communicating, reasoning, and connecting. They...	
Standard #5: use simulations to estimate probabilities.	Objectives: Students... • explore different types of probability distributions
Standard #5: use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty.	Objectives: Students... • understand when and how to estimate conditional probabilities and apply these methods to solve problems • test hypotheses by using appropriate, predetermined limits of significance
Standard #5: apply the concept of random variable.	Objectives: Students... • generate and interpret probability distributions including binomial, uniform, normal, and chi-square

Discrete Mathematics:

Students engage in problem-solving, communicating, reasoning, and connecting. They...

Standard #1: Represent problem situations using discrete structures such as finite graphs, matrices, sequences, and recurrence relations.

Objectives: Students...

- represent data (points) and solve problems using graphs, trees, networks, and matrices.
- make extensive use of Venn (and other) diagrams, along with logical connectives and statements to solve problems from real situations (e.g. economics, finance, sociology).

Standard #2: Represent and analyze finite graphs using matrices.

Objectives: Students...

- use finite graphs to represent networks from real problem situations, then use matrices to represent and analyze paths and other relationships

Standard #3: develop and analyze algorithms.

Objectives: Students...

- use algebraic and geometric iteration to explore patterns and solve problems.

Standard #4: Solve numeration and finite probability problems.

Objectives: Students...

- use manipulative, diagrams graphs, and technology tools to create and interpret discrete probability distribution.
- use counting principles such as factorial functions, combinations and permutations to solve problems.
- create different discrete probability distributions using technologies whenever appropriate.

Standard #5: Represent and solve problems using linear programming and difference equations.

Objectives: Students...

- explore, using manipulative and graphs, problems situations involving optimization.
- use algorithms for finding optimal paths and circuits in graphs.
- analyze different algorithms for efficiency in solving optimization problems.

Standard #6: Investigate and describe problem situations that arise in connection with computer validation and the application of algorithms.

Objectives: Students...

- analyze different algorithms for accuracy and efficiency, in solving optimization problems

Discrete Mathematics (continued)

Standard #7: Use inductive and deductive reasoning to investigate problem situations involving networks.

Objectives: Students...

- solve complex network problems, first experimentally, then using deductive reasoning to validate findings

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**Science
High School**

**Version 96.1
June 28, 1996**

Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework

Science
High School

Version 2.0
June 28, 1996

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Science in the Boston Public Schools: Introduction

Purpose

Put simply, the purpose of science education in the Boston Public School is for students to understand both how *to do* and *to use* science so they will value and participate in the intellectual, democratic, and vocational possibilities of science in American society.

The Nature of Science

Science may be simply described as human attempts to give good accounts of the patterns we see in nature. The characteristics of a “good account” and the particular “patterns we see” are the essence of scientific debate and consequence. The output of science, in its purist form, is ideas. At their scientific best, ideas become theories and laws. Overall, it may be said that the key criterion of science is that it is a clear, rational and preferably law-like account of a pattern in nature based on publicly accessible evidence and inferences, and accompanied by a model that offers a naturalistic explanation, whether conceptual, mathematical and/or mechanical.

The Use of Science

In its purist form science is an intellectual tradition, an inheritance of a set of ideas about nature: how it works, what is not yet known, and how to learn more. Because science has been successful from time to time in the foregoing pursuits, it is possible to use this information for practical efforts which make useful products of nature. This practical effort is called technology.

Our Standards

We have identified twelve standards in Science Understandings and Skills. These standards build from those identified in the National Science Education Standards and the Massachusetts Science Curriculum Frameworks. We expect all students to achieve the following standards, by the end of high school:

Science Understandings:

Standard #1: Students understand the role of observation and experimentation in the scientific process and the development of scientific theories.

Standard #2: Students understand the “big ideas” of science: the unifying concepts of the life sciences, physical sciences, and earth and space sciences.

Standard #3: Students have a deep understanding of the key concepts, principles, phenomena, and basic factual material included in at least one of the following subjects: biology, chemistry, or physics.

Standard #4: Students understand how humans use technology and the design process to respond to the natural world and to solve everyday problems.

Standard #5: Students understand humankind's interactions with nature over time, the technologies we have developed, the benefits and consequences of our actions, and the impact of science.

Standard #6: Students connect the study of science and technology to a variety of career opportunities.

Science Skills:

Standard #1: Students ask appropriate scientific questions, recognize experimental approaches to answering such questions, and develop their own answers to many questions through personal observation and experimentation.

Standard #2: Students gather scientific information through observation and experimentation in the laboratory and in the field; through questioning and interviewing; and through library work and other information-gathering activities.

Standard #3: Students organize the results obtained by observation, experimentation, questioning, interviewing, and library work, differentiating between evidence, inference, and opinion; they check and revise their explanations against scientific knowledge, experiences, and the observations of others.

Standard #4: Students communicate the results obtained by observation, experimentation, questioning, interviewing, and library work, through models, illustrations, narratives, and oral presentations.

Standard #5: Students research, analyze, and evaluate social, environmental, and personal challenges, problems and concerns, through observation, experimentation, research, and the application of the unifying concepts of science.

Standard #6: Students utilize appropriate technologies (including calculator-based laboratories, micro-computer based laboratories, CD-ROM, laser discs, and telecommunications), to expand the own capacity to obtain, utilize, and present information effectively, and to apply science principles to the solution of design/ engineering problems.

Criteria for the Development of the Science Standards and Curriculum Frameworks:

The following criteria guided the development of the K-12 science standards and curriculum framework for the Boston Public Schools. We chose to:

- Honor the intellectual coherence and common currency of each of the scientific domains (life sciences, physical sciences, space and earth sciences), while integrating content and instruction, wherever practical, through topics that will build students' understanding of concepts from more than one domain.
- Align our efforts with the National Science Education Standards, the Massachusetts Science Curriculum Framework, and the curriculum and materials development efforts sponsored by the National Science Foundation.
- Ensure that all students are engaged in hands-on science instruction in every grade.
- Ensure that all graduates develop scientific literacy in each of the major science domains and an in-depth understanding of at least one of the following domains: Biology, Chemistry, Physics.
- Ensure that good materials are available to teachers and students, given the standards we've developed for the particular grade levels.

- Seek a proper balance between depth of understanding and breadth of content covered. If we want students to *do* and to *use* science, they must have a deep understanding of the most essential science concepts, and be able to apply this understanding in meaningful ways. We have identified the minimum core science to be taught (70% of science instruction), while leaving teachers time for elective units (30% of science instruction).

Organization and Requirements:

Students in grades K-9 will study topics that include and often integrate concepts from the Life Sciences, Physical Sciences, Earth and Space Sciences, and Technology each year. Students in grades K-2 will receive a minimum of 90 minutes of hands-on science instruction per week. Students in grades 3-5 will receive a minimum of 135 minutes of hands-on science instruction per week. Students in grades 6-9 will receive a minimum of 225 minutes of hands-on science instruction per week.

High school level courses beyond the ninth grade will remain specialized, at least until more integrated materials are readily available. These courses will include Biology, Chemistry, and Physics at every high school in the city. Each student is required to successfully complete three years of high school science, including Integrated Science in the ninth grade, and either Biology, Chemistry, or Physics.

Format Guide:

The Curriculum Frameworks for each grade are arranged according to three categories: Student Requirements, Content Objectives (Topics), and Skill Objectives. Below are brief descriptions of each category.

1. **Student Requirements:** These are tasks students must complete as a condition of course completion.
2. **Content Objectives:** Each topic is described in five sections:
 - a. **Key Questions:** These are open ended, non-judgmental, inquiry-promoting questions that invite exploration of concrete, yet wide-ranging issues and problems. They do not address generic issues, such as “patterns” or “change,” nor do they ask for answers to specific queries, such as, “What is the speed of light?” To answer these questions well students must:
 - engage in disciplined inquiry, emphasizing the use of evidence, inference, and model building.
 - deeply understand key concepts and principles.
 - reference key people, events, phenomena, discoveries, documents, etc.
 - make connections between the content, their experiences, and the world outside of school.
 - communicate their findings clearly and precisely.
 - b. **Key Concepts, Principles, Lessons, and Phenomena:** These are the concepts, and lessons students must understand. Students will be able to clearly explain them, using real-world examples, apply them to the solution of real-world problems, and reference them when answering Key Questions.
 - c. **Entry Points and Applications:** These are people, events, objects, ideas, and themes that are especially provocative, illustrative, or accessible. They serve as entry points for, or examples/applications of, the content of each topic. Students will use these to enter, illuminate, or apply their knowledge of the topic, and to answer Key Questions.
3. **Skill Objectives:**
 - a. **Skills and Processes:** These are skills students must develop to conduct scientific inquiry.
 - b. **Technologies and Instruments:** These are items students will learn to use.
4. **The Science Domains: Grade Level Content Connections**

The topics of each grade are aligned with the *Massachusetts Curriculum Frameworks Science and Technology Curriculum Content Chapter: Owning the Questions*. Each Framework Strand has been woven into the BPS Curriculum Framework. Inquiry appears in the Key and Sub-Questions of each topic. The Technology and Human Affairs Strands are woven throughout the Key Questions; the Key Concepts, Principles, Lessons, and Phenomena; the Entry Points and Applications; and the Technologies and Instruments sections of the BPS Curriculum Framework.

In the section entitled "The Science Domains: Grade Level Content Connections", the Key Concepts, Principles, Lessons, and Phenomena from the BPS Curriculum Frameworks have been arranged in the appropriate Domains of Science (Life, Physical, and Earth and Space Sciences), as defined by the Massachusetts Curriculum Frameworks, to illustrate the connections between the Massachusetts and the BPS curriculum frameworks.

Ninth Grade Science:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Develop a portfolio of at least thirty illustrations of objects and phenomenon from throughout the school year.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Write book reports about famous scientists or inventors.
- * Make a presentation (to a large or small group of students and teachers) emphasizing the relationship between the evidence, inference and model used to explain one concept in one of the year’s topics.
- * Keep a notebook of their partial and complete answers to the Key Questions and Subquestions of each topic.
- Pass teacher tests of terms and concepts presented in the year’s topics.
- Complete their homework.
- Pass the Citywide Curriculum Assessment in ninth grade science. (Not a requirement for 1996-1997.)
- * Complete four “Boston Science Laboratory Reports” per science topic studied.
- Report on an interview with a practicing or applied scientist or an older BPS student who has completed a science fair project, or present their science exposition to young students and answer questions from them. (This make take the place of the presentation above.)
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip such as Whale Watch, Trailside Museum, Arnold Arboretum, or Community Project).
- * Complete a science exposition, including individual or team projects or whole-class theme-based projects with individually-differentiated tasks (see “Protocols” for Science Fair/Science Exposition).
- Report on a TV science or technology program.
- Read and summarize an original science report.
- * Complete one "Why This Topic?" summary or essay per topic.

Important Note:

All students are expected to complete two of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select two of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: Organic Inheritance (the replication, transcription and translation of genetic information)

Key Question: What is genetic information?

Subquestions:

- From where does genetic information come?
- Where does genetic information go?
- What does society do with genetic information?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- DNA structure as a model for information replication.
- Genetic Code as a language for translating information to products.
- Chromosomes as inheritable cellular components.
- Proteins as expressions of genes.
- Universality of the Genetic Code.
- * History of the Double Helix

Entry Points and Applications:

- DNA “finger printing”
- Genetic diseases: amniocentesis
- Human Genome Project
- Genetic engineering
- Genetic Counseling
- Sex-linked inheritance
- Mendel

Topic: The Surface of the Earth

Key Questions: Of what is the Earth made?

Subquestions:

- What forces shape the Earth?
- From where do rocks come?
- Where do rocks go?
- From where does water come?
- Where does water go?
- How do we determine the Earth’s age?
- How did the atmosphere come to be?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Geosphere.
- Hydrosphere.
- Atmosphere.
- Biosphere, especially the history of life on Earth.
- Mobility and composition of Earth’s surface.
- Rock cycles.
- Water cycles.
- Weather and climate

Entry Points and Applications:

- California earthquake (most recent)
- Dinosaur extinction
- Fossils
- Hurricanes
- Kracatoa
- Mt. Everest
- Charles Lyell
- Robert Balard
- Alfred Wagener
- *Basin and Range*, by John McPhee
- *The Blue Planet* (videodisk)
- *Principles of Geology*, by Charles Lyell
- *Wonderful Life*, by Stephen Gould

Topic: Waves

Key Questions: What are the properties of waves?

Subquestions:

- What do waves do?
- From where do waves come?
- Where do waves go?
- How are waves, especially electromagnetic radiation, used in American society?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Wave motion.
- Sources of waves.
- Characteristics of waves: frequency, wavelength, speed, amplitude, hertz, wave form (e.g. sound quality or timbre).
- Wave behavior: refraction, reflection, interference, diffraction, Doppler effect in light and sound.
- The electromagnetic spectrum, including transmission, absorption, and scattering.
- Speed of light.

Entry Points and Applications:

- Music and musical instruments
- Slinky
- AM/FM radio
- Microwaves
- X-rays
- Infrared radiation and night vision
- Stealth bomber
- Lasers
- Ultrasound

Topic: Structure of Matter

Key Question: Why does matter behave the way it does?

Subquestions:

- How is matter structured?
- How does matter change?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Atoms and molecules.
- Bonds.
- Periodic Table.
 - * elements.
- Temperature and heat.
 - * reactions: exothermic and endothermic.

Entry Points and Applications:

- DuPont
- Gun powder
- Soap
- Einstein
- Milliken
- Antoine Lavoisier
- Combustion
- Count Rumford
- Radioactivity

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Designing and conducting scientific investigations. Students:
 - a. Identify questions that guide scientific investigations,
 - b. Use technologies and mathematics to improve investigations and communications,
 - c. Formulate and revise scientific explanations and models using logic and evidence,

1. Designing and conducting scientific investigations (continued). Students:
 - e. Communicate and defend a scientific argument.
 - f. Develop understandings about scientific inquiry including:
 - Scientists are interested in physical, living, and designed systems, and are influenced by previous and current knowledge,
 - Scientists have several reasons why they make the investigations that they do,
 - Scientists rely a great deal on technology to enhance their data gathering and interpretation,
 - Scientists rely heavily, sometimes solely, on mathematics to develop explanations,
 - Scientific explanations have several criteria, including: they are logically consistent; they abide by the rules of evidence; they are open to question and possible modification; they base explanations on previous and current scientific knowledge.
 - Results of scientific inquiry emerge from different types of investigations and public communication among scientists. These results must be logical and make connections between natural phenomena, investigations, and the historical body of scientific knowledge. The methods and procedures used must be clearly reported to enhance opportunities for further investigation.

(This set of skills contributes to fulfilling the ability “to do science” portion of the Purpose.)
2. Evaluating social or personal issues in terms of how science can and cannot contribute to their clarification and resolution. Students:
 - a. Identify aspects of social and personal issues which can be addressed through scientific study
 - b. Clarify differences between personal and social values and scientific knowledge
 - c. Prudently apply scientific knowledge to social or personal issues.

(This skill, in addition to those in Item 1, contributes to fulfilling the ability “to use science” portion of the Purpose.)

* Adapted from the National Research Council’s *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- Microscope • Telescope • Triple beam balance • pH meter
- Anemometer • Barometer • Thermometer • Propane burners
- Computers • CD ROM • Laser disks • Computer probes
- Internet for data collection • Overhead projector • SLR camera
- Ocean floor maps • Satellite maps • Magnetic field maps

Students will be able to measure science phenomena using a CBL sensor interfaced with a graphing calculator or similar probe, with a desk computer.

The Science Domains: Ninth Grade Content Connections

Life Sciences

- Structure of DNA
- Genetic code
- Chromosomes
- Cells
- Inheritance
- Proteins
- Reproduction of cells

Physical Sciences

- Wave motion
- Characteristics of waves
- Electromagnetic waves
- Speed of light
- Sources of waves
- Uses of electromagnetic waves

Earth and Space Sciences

- Geosphere
- Biosphere
- Composition of the Earth’s surface
- Rock cycle
- Water cycle, surface water, ground water
- Hydrosphere
- Atmosphere
- Volcanism, earthquakes, mountain building, metamorphism
- Continental drift and plate tectonics
- Dating methods
- Convection currents

High School Biology:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Develop a portfolio of at least thirty original illustrations of objects and organisms from throughout the school year.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Write book reports about a biologist or the history of a biological discovery.
- * Make a presentation (to a large or small group of students and teachers) of one concept, emphasizing the relationship among evidence, inference and models.
- * Keep a notebook of observations, evidence, inference, models, charts and graphs and partial and complete answers to the Key Questions and Subquestions of each topic.
- Pass teacher tests of terms and concepts presented in the year’s topics.
- Complete their homework.
- * Complete four “Boston Science Laboratory Reports” per science topic studied.
- Report on an interview with a practicing biologist, medical researcher or bioengineer (interviews can be undertaken individually or in small groups).
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip to DOE or EPA).
- * Complete a science exposition, including individual or team projects or whole-class theme-based projects with individually-differentiated tasks (see “Protocols” for Science Fair/Science Exposition).
- Report on a TV science or technology program.
- Read and summarize an original biology report.
- * Complete one "Why This Topic?" summary or essay per topic.

- Optional: Complete a test preparation workbook for the Biology Achievement Test.

Important Note:

All students are expected to complete two of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select two of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: Living Things

Key Question: What characterizes living things?

Subquestions:

- What is the design (structure) of living things?
- How are living things studied?
- What kind of chemistry characterizes life?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Living things are variations on a few themes (characteristics of life).
- Biology is a science and therefore studies living things with scientific purposes, attitudes, techniques and instruments. Understanding evidence, inference and models are keys.
- Living things are chemical and may be examined in terms of chemical substances and processes.

Entry Points and Applications:

- Stephen Gould, *Wonderful Life* • Edward Wilson, *Naturalist* • Arnold Arboretum
- Evelyn Fox Keller, *A Feeling for the Organism: The Life and Work of Barbara McClintock*
- Ernst Mayr, *The Growth of Biological Thought* • Lewis Thomas, *The Medusa and the Snail*
- Ed Wilson, *The Diversity of Life* • New England Aquarium • Franklin Park Zoo
- *The Norton Reader: An Anthology of Expository Prose* (6th Edition) See science essays, pp. 888-984. (Authors include Rettie, Lorenz, Tinbergen, Russell, Gould and others).
- Museum of Comparative Zoology

Topic: Cells

Key Questions: What characterizes cells?

What do they do?

How do they do it?

Subquestions:

- How are cells structured?
- How do cells function?
- How are cells similar to and different from one another?
- Where do cells come from? Where do they go?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- All living things are comprised of cells and their products (“organisms as republics of elementary living units” Mayr, *Growth...* p. 657).
- Energy must be utilized for cells to function.
- Cells reproduce to effect changes in size, shape and function.

Entry Points and Applications:

- M. J. Schleiden (1804-1881) • Theodor Schwann (1810-1882)
- E. E. Just (1883-1942)
- Lewis Thomas, *The Lives of a Cell* • Lynn Margulis

Topic: The Organism

Key Question: How do organisms survive?

Subquestions:

- What fundamental biochemical/physical problems do organisms “solve?”
- How are organismal design solutions similar and different?
- What is a good organism?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Each kind of organism represents a different strategy for solving basic life sustaining problems. Strategies are revealed in organismic structures and function. Human beings are a “special case” organism.

Key Concepts, Principles, Lessons, and Phenomena (continued):

Students will understand...

- Basic problems are a) procuring nutrition, b) exchanging gases, c) internal transport, d) regulating body fluids, e) controlling chemicals, f) nervous control (in animals), g) movement in the environment, h) intraspecific behavior.
- The value of organisms is a function of societal values.

Entry Points and Applications:

- Diversity of life forms • Stephen Gould, *Wonderful Life*
- Case study of organisms with aesthetic, sport, agricultural or medical benefits (horses, dogs, sheep, chickens, cattle, rabbits, snakes, cats, rats, cockroaches, honeybees, etc.)
- Phyla dinner (plan a palatable dinner which includes the largest number of different kinds of organisms)
- Mary's Mystery (HMS Case)

Topic: Cellular Inheritance (Classical and Molecular Genetics)

[Note: This unit shares many similarities with the 9th grade unit on Organismic Inheritance.]

Key Question: What is genetic information?

Subquestions:

- How is genetic information stored, communicated, and reproduced?
- Where does genetic information come from?
- Where does genetic information go?
- How is genetic information utilized by society?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- DNA structure as a model for information replication.
- Genetic Code as a language for translating information to products.
- Chromosomes as inheritable cellular components.
- Most cells can make an exceptionally accurate but not perfect duplicate of themselves undergirds both life's continuity and variation.
- Proteins as expressions of genes.
- Universality of the Genetic Code.
- Humans can partially change an organism's genetic complement, including that of humans.

Entry Points and Applications:

- DNA fingerprinting • Genetic diseases • Boston University's City-Lab
- James Watson, Francis Crick, Maurice Wilkins, Rosalind Franklin
- Original Watson and Crick paper in *Nature*, 1953
- Watson, *The Double Helix*

Topic: Growth and Differentiation

Key Questions: What characterizes change in an organism's lifetime?
What can go wrong?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Differentiation and pattern formation.
- Fertilization.
- Embryonic development.
- Maturation, aging, response to injury.

Entry Points and Applications:

- Human pregnancy
- Caterpillars, chrysalis, butterflies
- The Ugly Duckling story
- Artificial limbs
- Senility
- Physical and physiological healing

Topic: Life and Environment

Key Question: How do organisms relate to other organisms and to non-life?

Subquestions:

- What are energy flows?
- What are material cycles?
- What characterizes life and the environment in American society?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Ecosystems.
- Population growth and decline.
- Biomes.
- Spaceship Earth.
- Indicator species.
- Species extinction.

Entry Points and Applications:

- Specific endangered species
- Boston Harbor
- Tropical rain forests
- Bioconservation
- Ed Wilson, *Biodiversity*

Topic: Organic Evolution

Key Question: What is the history of life on Earth?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Evolution.
- Natural selection.
- Fossil record.
- “Deep time.”
- Adaptation.
- Genetic variation in populations.
- Animal breeding analogy.

Entry Points and Applications:

- Dinosaurs
- Breeds of animals
- Stephen Gould’s *Wonderful Life*
- Earth/meteor collisions
- Ice age mammals
- Trilobites
- Darwin, *Origin of Species* and *Autobiography*

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Designing and conducting scientific investigations. Students:
 - a. Identify questions that guide scientific investigations,
 - b. Use technologies and mathematics to improve investigations and communications,
 - c. Formulate and revise scientific explanations and models using logic and evidence,

1. Designing and conducting scientific investigations (continued). Students:
 - e. Communicate and defend a scientific argument.
 - f. Develop understandings about scientific inquiry including:
 - Scientists are interested in physical, living, and designed systems, and are influenced by previous and current knowledge,
 - Scientists have several reasons why they make the investigations that they do,
 - Scientists rely a great deal on technology to enhance their data gathering and interpretation,
 - Scientists rely heavily, sometimes solely, on mathematics to develop explanations,
 - Scientific explanations have several criteria, including: they are logically consistent; they abide by the rules of evidence; they are open to question and possible modification; they base explanations on previous and current scientific knowledge.
 - Results of scientific inquiry emerge from different types of investigations and public communication among scientists. These results must be logical and make connections between natural phenomena, investigations, and the historical body of scientific knowledge. The methods and procedures used must be clearly reported to enhance opportunities for further investigation.

(This set of skills primarily contributes to fulfilling the ability “to do science” portion of the Purpose.)

2. Evaluating social or personal issues in terms of how science can and cannot contribute to their clarification and resolution. Students:
 - a. Identify aspects of social and personal issues which can be addressed through scientific study
 - b. Clarify differences between personal and social values and scientific knowledge
 - c. Prudently apply scientific knowledge to social or personal issues.

(This skill, in addition to those in Item 1, contributes to fulfilling the ability “to use science” portion of the Purpose.)

* Adapted from the National Research Council’s *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- Triple beam balance • pH meter • Thermometer • Ammeter • Calorimeter
- Galvanometer • Computer software • Spectrophotometer • Gel electrophoresis
- Paper chromatography • Microscope

Students will be able to measure science phenomena using a CBL sensor interfaced with a graphing calculator or similar probe, with a desk computer, to collect and statistically analyze experimental data to produce tables, charts, and graphs.

Students will be able to use computer simulations for population studies, hazardous or expensive chemical reactions, and hypothetical physical situations.

High School Chemistry:

Student Requirements: As a condition of course completion, students must...

See attached “Protocols For Student Requirements In Science” for more detailed descriptions of some of these requirements.

- * Develop a portfolio of at least thirty original illustrations of objects and organisms from throughout the school year.
- Gather a series of photographs throughout the year, as part of a class portfolio in science, showing class members (singularly and in groups) engaged in science.
- Write books reports about chemists or the history of chemical discoveries.
- * Make a presentation (to a large or small group of students and teachers) emphasizing the relationship between the evidence, inference and model used to explain one concept in one of the year's topics.
- * Keep a notebook of their partial and complete answers to the Key Questions and Subquestions of each topic.
- Pass teacher tests of terms and concepts presented in the year's topics.
- Complete their homework.
- * Complete four “Boston Science Laboratory Reports” per science topic studied.
- Report on an interview with a practicing chemist or chemical engineer.
- Participate in at least one outside of school science activity with the class; a parent, sibling, or other adult; or a community-based organization (e.g. visit a science museum, attend a science presentation, go on an extracurricular field trip such as Whale Watch, Trailside Museum, Arnold Arboretum, or Community Project).
- * Complete a science exposition, including individual or team projects or whole-class theme-based projects with individually- tasks (see “Protocols” for Science Fair/Science Exposition).
- Report on a TV science or technology program.
- Read and summarize an original chemical report.
- * Complete one "Why This Topic?" summary or essay per topic.

- Optional: Complete a test preparation workbook for the Chemistry Achievement Test.

Important Note:

All students are expected to complete two of the starred (*) products during the 1996-97 school year. Teachers, working together by grade level or school, will select two of these products as the focus of special attention during the school year. Task descriptions for each product will be completed during the summer. Teachers, students, and parents may use these descriptions as guides as students develop their products, and as tools to help them assess students' work. During the summer of '97, we hope to bring teachers together to examine and discuss samples of students' work, and to refine the task descriptions we use to guide and assess it.

Content Objectives:

Topic: Water

Key Question: What is water quality?

Subquestions:

- What are the characteristics of water?
- Where does water come from?
- Where does water go?
- What are the characteristics of water mixed with other substances?
- How is water used in American society (kinds of uses, amount used)?

Note: See attached "Giving Good Accounts of the Patterns We See in Nature: Guidelines for Science Lessons in Boston."

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Properties of water (physical properties and changes of state, including energy changes associated with changes of state).
- Hydrologic cycle (water sources and sinks).
- Impurities in water (properties of solutions, chemical equilibria, acid-base reactions, redox reactions).

Entry Points and Applications:

- A battery
- Cases of water quality, contamination, purification (e.g. MWRA drinking water quality, Charles River water quality, Boston Harbor water quality)
- Cases of water use: biological (personal, ecological), home, commercial and industrial (e.g. industrial and commercial indices of water quality)

Topic: Mineral Resources

Key Question: What is a good mineral?

Subquestions:

- What characterizes minerals?
- Why do minerals have these characteristics?
- Where do minerals come from?
- Where do minerals go?
- How are minerals used in American society (kinds of minerals and their products, amounts of minerals and their products)?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Solids (compounds and pure) have a characteristic molecular structure that is a function of the kinds and arrangement of their atoms.
- The priorities of mineral elements and their natural occurring ores 1) are a function of their molecular structure and 2) dictate their human and cultural uses.
- The distribution (physical and economic) of mineral resources influences their availability and cost.
- Periodic table and atomic structure of matter.

Entry Points and Applications:

- Diamonds and other gems (crystals), including gem appraisal
- Historical metals: bronze, pewter, steel, stainless steel
- Locations of and techniques for collecting gold, silver, copper and iron
- Dmitri Ivanovich Mendeleev

Topic: Petroleum

Key Question: What are the characteristics and uses of petroleum?

Subquestions:

- Why does petroleum have these characteristics?
- Where does petroleum come from?
- How is petroleum used in American society (kinds of petroleum and their products, amounts of petroleum and its products)?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Physical and chemical properties of petroleum.
- Combustion and energy transformation.
- Energy sources for industrial society.
- Physical and chemical properties of hydrocarbons (carbon chains and rings).
- Energy transformation, including exothermic and endothermic reactions, combustion, catalysts, rates, and bonds (chemical thermodynamics and kinetics).
- There are carbon fuels other than those based on petroleum (coal, wood, buffalo chips, whale oil).
- Energy and material products of large scale industrial combustion have local, regional, and global consequences.

Entry Points and Applications:

- Global warming
- Internal combustion engine
- Oil refinery
- Wood stove

Topic: Chemical Characteristics of Food

Key Question: What is good food?

Subquestions:

- What is food?
- What is the chemistry of food (energy, substances, flavor)?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Food is the appropriate 1) amount and 2) kind of chemicals needed to sustain the chemical reactions and materials of living things.
- Taste is a chemical interaction between the food material and the physiology of the organism.

Entry Points and Applications:

- Energy content of sugar, starch and cellulose
- Insect repellents
- Chile pepper oils and “what’s hot”
- Oleomargarine

Topic: Nuclear Chemistry

Key Questions: What is radioactivity?

What does radioactivity reveal about the nature of the atomic nucleus?

Subquestions:

- What characterizes radioactivity?
- Why are some substances radioactive?
- Where does radioactivity come from?
- Where does it go?
- How is the atomic nucleus structured?
- How is nuclear energy used in American society (medical, industrial, and military)?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Evidence for and models of atomic nuclei.
- Relationship of energy and matter at the subatomic level.
- Isotopes.
- Science of splitting and fusing atoms.
- Cases of medical, industrial and military applications of nuclear energy.

Entry Points and Applications:

- Atomic bomb
- Cloud chambers
- “Cold fusion”
- X-rays
- Nuclear reactors
- Radioisotopes in medicine
- Marie Curie

Topic: Atmosphere

Key Question: What is atmospheric quality?

Subquestions:

- What are the properties of gases?
- What are the characteristics of the atmosphere?
- How does the atmosphere interact with extraterrestrial influences (electromagnetic spectrum, meteors)?
- How does the atmosphere interact with terrestrial influences (natural, manmade)?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Atmosphere as a “sea of air”.
- Air as a finite natural resource.
- Air quality is a function of natural and human interactions.
- The gas laws.
- Kinetic theory of gases.
- Electromagnetic spectrum and the atmosphere.
- Air pollutants: origins, chemistry, consequences.
- Cases of changes in air quality.

Entry Points and Applications:

- Acid-rain
- Smog
- Robert Boyle

Topic: Chemical Characteristics of Health

Key Question: How is health chemical?

Subquestions:

- What is cellular health?
- How is it chemically maintained and abused?
- What is physiological health (bodily)?
- How is it chemically maintained and abused?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Cells are chemical structures and processes, susceptible to temporary and permanent disruption; human physiology manifests many chemical structures and processes, susceptible to temporary and permanent disruption. Disruption is induced by internal and external substances.
- Cell as chemical structure and process.
- Physiology as chemical process.
- Pharmacology and toxins.
- Cases of chemical use, abuse, and accident (medicine, drugs, poisoning).

Entry Points and Applications:

- Aspirin
- Caffeine
- Carbon monoxide
- Cyanide
- Nicotine

Topic: The Large Scale Design and Manufacture of Chemicals for Human Use

Key Question: What is chemical engineering?

Subquestions:

- How are chemicals identified for human use (medical, agricultural, industrial)?
- How are chemicals manufactured for human use?

Key Concepts, Principles, Lessons, and Phenomena: Students will understand...

- Human need and economic feasibility motivate chemical engineering.

Key Concepts, Principles, Lessons, and Phenomena (continued): Students will understand...

- Cases of chemical engineering, including the drug industry.

Entry Points and Applications:

- Fiberglass
- Gore-tex
- Kevlar
- Plastic
- Soap, detergent, and shampoo

Skill Objectives

Skills & Processes: Students will develop the abilities necessary to do scientific inquiry by*:

1. Designing and conducting scientific investigations. Students:

- Identify questions that guide scientific investigations,
 - Use technologies and mathematics to improve investigations and communications,
 - Formulate and revise scientific explanations and models using logic and evidence,
 - Recognize and analyze alternative explanations and models,
 - Communicate and defend a scientific argument.
- f. Develop understandings about scientific inquiry including:
- Scientists are interested in physical, living, and designed systems, and are influenced by previous and current knowledge,
 - Scientists have several reasons why they make the investigations that they do,
 - Scientists rely a great deal on technology to enhance their data gathering and interpretation,
 - Scientists rely heavily, sometimes solely, on mathematics to develop explanations,
 - Scientific explanations have several criteria, including: they are logically consistent; they abide by the rules of evidence; they are open to question and possible modification; they base explanations on previous and current scientific knowledge.
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2. Evaluating social or personal issues in terms of how science can and cannot contribute to their clarification and resolution. Students:

- Identify aspects of social and personal issues which can be addressed through scientific study
- Clarify differences between personal and social values and scientific knowledge
- Prudently apply scientific knowledge to social or personal issues.

(This skill, in addition to those in Item 1, contributes to fulfilling the ability “to use science” portion of the Purpose.)

* Adapted from the National Research Council’s *National Science Education Standards* (1996).

Technologies and Instruments: Students will be able to use...

- Ammeter
- Calorimeter
- Galvanometer
- pH meter
- Thermometer
- Triple beam balance

Students will be able to measure science phenomena using a CBL sensor interfaced with a graphing calculator or similar probe, with a desk computer, to collect and statistically analyze experimental data to produce tables, charts, and graphs.

Students will be able to use computer simulations for population studies, hazardous or expensive chemical reactions, and hypothetical physical situations.

Protocols for Student Requirements in Science:

The purpose of the protocols is to describe minimum requirements for successful fulfillment of student responsibilities in science. In addition, the protocols supply a list of resources that might be used by the teacher, student, parents and/or guardian. In support of these student requirements, the Boston Public Schools recognizes that it must provide rubrics and exemplars that clarify the types and quality of work expected of students, grades K-12, and that promote the kinds of science teaching and learning required throughout the curriculum.

1. The Boston Science Laboratory/Activity Report

The Boston Science Laboratory/Activity Report is required of all students at all grade levels. For grades K-5, the report is called a Science Activity Report. For grades 5-12, the report is called a Science Laboratory Report. The difference in names reflects differences in mode of communication, required content, and comprehensiveness and sophistication of presentation and analysis, in relation to the expected cognitive and experiential ability of the student.

The purpose of the report is to promote clear and logical communication about scientific ideas between the person conducting the investigation and his/her audience. At the kindergarten level, the report can be as simple as a child reporting to the teacher what she/he sees, hears, or feels, and what she/he thinks about the observations. This oral report might be accompanied by a drawing or short written statement. For example, a child feels the fur on a bunny or gerbil (the observations) and states that the fur is soft and keeps the animal warm (the inference or explanation). The child draws a picture of the animal, with emphasis on the fur, or writes a sentence reflecting the observation and explanation. As children become older, more informed, and more sophisticated, the format and content of the Science report parallels this growth.

Science Activity Report Format

Grades K-2: The basic format is 1) an observation based on direct sense perception of a natural phenomenon or object and 2) a statement (oral or written) of interpretation (inference, explanation, metaphor). Natural phenomena or objects includes all things of nature (animals, clouds, plants, rocks and soil, human body, etc.) as well as manipulations of nature as seen in experiments. Statements of interpretation are any ideas that go beyond what is directly perceived by the senses. For example, an animal's fur is for keeping it warm, an animal drinks water because it is thirsty, or the sun feels hot because it is made of fire.

Grades 3-5: The format remains the same as K-2 but with the following two additions: 1) The report must be written and 2) the data of the observation must be included in the form of a drawing or illustration, or chart or graph. It will help the child to note that their report is meant to answer, at least in part, one or more of the key questions.

Reports will begin with a) a title and listing of the phenomenon or object of study, b) the specific observations that the child made, c) the data that support the observation, and d) the interpretation of what was observed. See sample Science Report.

Science Laboratory Report Format

Grades 6-8: The core of the report remains the same as the "Science Activity Report," but the student makes observations that are more elaborate and precise, and often involve instruments, while the interpretations include conceptual, mathematical or mechanical explanations. In addition, the introduction should explicitly state how the report contributes to the student's answer, at least in part, to the key questions of the lesson. See sample Laboratory Report.

Grades 9-12: There are two points for consideration at this level of development, the content of the study and the format of the report. What follows are guidelines.

First, in terms of the Boston science curriculum, student laboratory investigations should help the student address, even answer, the key questions of the units. By addressing the key questions the laboratory report becomes an integral part (in the sense of coordination and coherence) of the CONTENT as well as the PROCESS of science. Nevertheless, student interest should also play a part in determining the topic of investigations. The balance between these two must be determined by the teacher and student in reference to the content of the curriculum and the student's need to develop scientific competence and confidence.

Second, in terms of the format of the Boston Science Laboratory Report, the following represents a synthesis of several extant formats used by high school and college faculty. Other formats are equally legitimate but it seems that some effort to adopt a common form is preferable at this time in the history of science education in Boston.

Reports should include:

a. A Title

b. A Statement of Question or Purpose: For example, "The purpose of this scientific investigation is to determine quantitatively the relationship between the quality (color) and quantity (intensity) of visible light and the rate of growth (biomass/time) of bean seedlings."

c. An Explanation of the Study Context: In this section the student lists the reasons why the study is undertaken. For example, the study may be an extension of a class laboratory experiment; it may be an investigation that is personally interesting; it may grow out of a question that arose from the student's reading (text, science report); or it may spring from the larger scientific research community where the student participated in a research laboratory program.

d. Procedures and Materials: The procedures and materials section describes the investigative approach and apparatus used to conduct the investigation or experiment. Unfortunately, in the hands of many school students, this section is overrun with grocery lists of everyday items (e.g. ruler, scotch tape, test tubes) and is short on the specific and essential procedures that guarantee the success of the technique. A well written procedures and materials section is characterized by a succinct style. One good drawing or photograph, with labels, can suffice for many words.

e. Results: Data are the evidence about which we have some confidence and from which we make our inferences. Students should learn to prize this section of the report. The effective visual display of data, quantitative or qualitative, is an essential scientific skill because the form in which data are arranged contribute greatly to revealing the patterns which illustrate the underlying regularities of nature. Charts and graphs need to be neat, precisely and succinctly labeled, and include only those data which are relevant to the study.

f. Discussion: This section gives the student's evaluation of the results of the study; her confidence in the evidence; the inferences she made; and the models, whether conceptual, mathematical and/or mechanical, that she invented or employed to give an account of the natural phenomenon as she saw it revealed in the data. Further, it is the place where the student may suggest further questions or even speculate, with care, about next moves. This is also the place where the student address the personal and societal importance of the investigation by answering the questions "What does this mean for you and society?" and "So what?"

g. References

2. Nature Illustrations

The purpose of illustrations is to increase the student's ability to observe nature precisely and thoroughly. These are fundamental skills for all scientists and skills that can serve in all walks of life. The notebooks of famous scientists are filled with illustrations. The *National Science Education Standards* begins each grade level section of the book with a page taken from a portfolio of school students' illustrations (see attached illustrations).

In addition, young people are exceptionally visually oriented and illustrating can build on this ability. Nature and scientific illustration, it should be noted, is a skill that improves with practice. Although some children appear to have more talent, all children get better at illustrating over time. With regard to science, this simply means that all children can become better observers of nature. Teachers profit, as well, from practicing nature illustrations.

Although it is hard to state what constitutes a good illustration, there are a few criteria that must be kept in mind. Because this is science, a key criteria is accuracy. Accuracy refers to the degree of correspondence between what is emphasized in the drawing and what the phenomenon looks like. For example, for very little children, accuracy might be the ability to choose the right color crayon to fill in a scientific illustration of their banana. Given little children, the banana may be round, long and thin, or even pear shaped. The lack of shape accuracy is not emphasized because it is developmentally inappropriate.

By third grade, however, bananas need to be both yellow (as long as they aren't the green type of bananas) and shaped like a banana. But it may be inappropriate for the child to be asked to color the subtle shades of green, yellow, cream, brown, tan and black that characterize most ripe bananas.

By eighth or ninth grade, if color is the natural feature under inspection, students should be able to execute a rich, holistic, coloring of the banana. A similar developmental scheme can be established for other features of nature such as shapes, orientation, position and numbers of organisms and their parts, and the scale of organisms one to another and to features of their environs.

Furthermore, all efforts to illustrate should teach the student to seek and emphasize the distinguishing feature(s) of the natural object or phenomenon. Examples include a tiger's vertical stripes, the red of a cardinal, the leglessness of a snake, the huge eyes of a dragonfly, or the fact that a fish's tail is vertical whereas a whale's tail is horizontal, or an insect has six legs while a spider has eight and a centipede has many.

3. Photographs of Student Action

Most kids love to show pictures of themselves. This responsibility builds on that enjoyment by asking groups of students to create a photo album of themselves and their classmates engaged in doing science. Photos should include students working with scientific apparatus, participating in field studies, or presenting their scientific studies to other students or family. Photos may also include pictures of students meeting with scientists and engineers (see Protocol for Interviewing, below). These photos can become part of a class portfolio in science. See attached photos for examples.

In addition to the personal collection, photographs build community (it is difficult to take a candid picture of yourself) and lend an air of fun to science classrooms.

A number of teachers at several grade levels in the Boston Public Schools already ask students to take pictures of themselves and their classmates. They report that the students enjoy and profit from the work and that it contributes to an enjoyable and supportive classroom environment.

4. Interview with a Practicing or Applied Scientist; Interviewing an Older BPS Science Student

Interviewing A Practicing Or Applied Scientist:

Students at all levels should see and talk with practicing scientists and people who work in scientific fields. Scientists, engineers, zoo keepers, meteorologists, pet store owners, horticulturists, and farmers, among others, make their living by dealing directly with natural objects and phenomenon. They have interesting stories to tell and can extend school science far beyond the classroom walls.

For the youngest children, an interview may simply be a group interview that takes place in the classroom when a scientist or veterinarian comes to visit. By middle school level, this group interview may suffice, but it is preferable that students work in pairs or small teams to meet an engineer or farmer. In these middle school interviews, whether whole class or small group, students should try to determine what the person does, how science is used in their work, what they think science is all about, and what training or education is needed for their work. This information should be compiled and discussed by the teacher and the class.

High school students should try to travel to the site of the interviewee's work, so they are meeting the person in the context of his or her life's efforts. It is noted, however, that practical circumstances may limit high school students to conducting their interviews as a whole class and in the school building. High school students will be asked to "write-up" the results of the interviews and to send a thank-you note to the interviewee.

At any grade level, photographs of students conducting interviews can contribute to the fulfillment of the photograph responsibility.

Interviewing Older BPS Students:

A second kind of interview includes young students meeting with older BPS students in a formal discussion about particular science activities and projects. Specifically, middle or high school students who have completed high quality science fair projects are invited to present their work to younger students and to respond to questions about their projects (and to science inquiry in general).

5. Summarize an Original Science Report

This requirement exists only at the high school level. Its purpose is to engage the student with original scientific reports or parts of reports, such as especially rich graphs or illustrations. In one form, this report asks the student to identify the evidence, the inferences, and the model which are used by the scientists. In another form, the student is asked to paraphrase or summarize (a very hard exercise, even with the paper's abstract in hand) the content of the scientific paper. For students who may be severely challenged by the level of writing in original scientific papers, other writing may be substituted. For example, there are many popular accounts of nature (Lewis Thomas, Stephen Gould, science sections in newspapers, or even their classmates Science Laboratory Reports), several of which are accessible, even to readers who are below grade level.

6. Documentation of the Extracurricular Science Activity

Students complete a one-page form that asks them to list the activity (date, time, place, or a picture for younger children), briefly describe the activity, and suggest how it contributes to answering one or more of the key questions in their science curricula.

A parent/guardian signs the report and also writes a sentence in which they state what they think their child learned from the activity.

Possible sources of extracurricular science include: Museum of Science, New England Aquarium, Computer Museum, Arnold Arboretum, Boston Park Service Activities, Whale Watch, Trailside Museum, Blue Hills Reservation, Museum of Comparative Zoology, Franklin Park Zoo, Harvard College Observatory.

7. Report on a Book about Scientists or Inventors

In an effort to enrich the student's understanding of the lives of scientists, the historical and social contexts of science, and the nature of science itself, BPS students at all levels are to read or listen to, talk and/or write about books about scientists and inventors.

For grades K-2, the approach to books about scientists is the same as the approach to any other children's literature. Children should be read to; read if they are able; talk; and write, if that is appropriate. Story circles are recommended.

For grade 3-12, children and youth should read books about scientists and inventors. They should discuss these books in small groups and whole class settings. They should be asked to write about what they read. Techniques for engaging students with books about science are more or less the same as those for other forms of literature, bearing in mind that certain literary forms, such as expository prose, are more germane to the purpose of science than, say, epic poetry, because, perhaps, imagination and purpose in science are not the same as imagination and purpose in art.

8. Science Fair/Science Exposition

The purpose of the Science Fair/Exposition Project is similar to that of the Science Activity/Laboratory Report--to promote clear and logical communication about scientific ideas between the person conducting the investigation and his/her audience. However, the Science Fair/Exposition Project goes beyond written reports to include physical demonstrations and verbal support. Projects can be natural extensions of topics covered in class or can focus on other interests of the students, such as an investigation that is personally interesting, a question that arose from the student's reading (text, science report), or the larger scientific research community where the student participated in a research laboratory program.

Grades 3-5: At this level, students' projects (individual, team, or class projects) should explore questions based on their observations of the natural world. Students should gather evidence to answer their questions and may want to use a model to describe and/or analyze the phenomenon they are studying. Projects should be evaluated, but not competitively.

Grades 6-8: Students at this level must complete individual projects (team or whole-class theme-based projects are acceptable if each student has an individually-differentiated task) and should participate in an exhibition with some degree of competition. Students must pose a question or define a problem, propose a likely answer or solution, design and conduct a test or experiment (following humane and safety guidelines) or analytically describe the outcome in the case of non-experimental inquiries, and use the compiled data to evaluate the accuracy of the proposed answer, noting its strengths and weaknesses.

Throughout the project, students should keep a notebook of their progress and find at least three references to support their work. Presentations must incorporate visual aides, including charts or tables of data, and an verbal defense of the methods and results.

Grades 9-10: Students must enter individual projects in an exhibition with a competitive phase. Students must define a problem, articulate a hypothesis, design and conduct a procedure with a control and variable to test the hypothesis (following humane and safety guidelines), and use the compiled data to evaluate the accuracy of the hypothesis and its strengths and weaknesses.

Throughout the project students must record their procedures in a notebook. Students must write a report including at least three references to support their work. Presentations must include visual aides, including charts, tables or graphs, and an verbal defense of the report.

Grades 11-12: The basic format remains the same as the Grades 9-10 project. In addition, experiments should involve multiple variables. The report must include a rationale for the sample size and experimental procedures, an application of statistics (averages, ranges, etc.) to

the data, graphs, at least three references (including one from a recent journal), and a revision of the hypothesis or model based on the results of the study. Students should also evaluate competing explanations for their phenomena. Presentations must include visual aides and an oral defense using a theoretical model to explain the results.

District and building guidelines should be consulted for further details.

9. Why This Topic?: Summary or Essay

Students and teachers should know why they are studying what they are studying. To ensure this exploration of the curriculum, students and teachers must examine the reasons why each science topic and related activities are included in the curriculum. Specifically, by the end of the instruction of the topic, each student will address, at developmentally-appropriate levels, the reasons why the topic is studied. Such reasons may include, but are not necessarily limited to, the role of science in society, in the curriculum, and in the lives of students, teachers and others. In addition, the address should directly examine the key questions of each topic.

The “reasons why” will vary by subject, teacher and class, and the address will undoubtedly recur throughout the course of instruction. Teachers are encouraged to promote and allow, without punitive evaluation, “hard questions” about the curriculum, even to the point where the student can present a very strong case for some other form of school science. The point is to emphasize “giving reasons with evidence and probable consequences.” This form of thinking is essential for good science.

Grades K-5: Learners in these grade levels can express their understandings through oral and written statements. These may be limited to one or a few reasons.

Grades 6-8: Learners in these grade levels should organize their understandings in the form of a list of reasons, including evidence and possible outcomes.

Grades 9-12: Learners in these grade levels should prepare their address in the form of an essay, perhaps of 1-2 pages length in ninth and tenth grade and 3-5 pages length in eleventh and twelfth grades. (See the writing standards in the English Language Arts curriculum.)

A Checklist of Inquiry Questions for Teachers of Science*:

The following questions should be frequently heard (from both teachers and students) during science lessons. Some questions may need to be translated to a level that is appropriate for learners of different developmental abilities and knowledge. Rather than teachers directly answering the questions, students' observations should lead them to the answers to the questions.

Description

- What is it?
- What does it do, or what is its function?
- Is it typical?
- Is it real or an artifact? (Is the phenomenon really there or is it created through the experimenter's manipulation?)
- What is its significance/importance/advantage?

Investigation

- Can it be investigated scientifically?
- How can I find out about it?
- How does it work/happen?
- How does/did it begin?
- What causes it to happen? (Is there a cause/effect relationship, or just a correlation?)
- What affects it, and what does it affect? (How does it fit into the whole picture?)

Prediction

- What are the expected results?
- What would happen if _____?
- Has it changed or does it change through time?
- What are its future risks, benefits, or consequences?
- Does it always happen like this?
- Can knowledge about it be used to solve problems or be applied to other situations?

Evidence and Inference

- What is the evidence?
- Are the data/facts about it accurate?
- What inferences can I make from the evidence?
- On what assumptions is the evidence/inference based? Are the assumptions tenable?

Explanation

- What concepts, formulas and/or mechanisms apply to the phenomenon?
- What model can be built or adopted to explain the phenomenon?
- How do I support my position about it?
- What other questions do I need to ask about it?

* BSCS. *Developing Biological Literacy*. (1993). Dubuque, IA: Kendall/Hunt Publishing.

**Boston Public Schools
Citywide Learning Standards
and
Curriculum Framework**

**High School
Social Studies**

**Version 96.1
June 28, 1996**

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Social Studies in the Boston Public Schools:

Introduction: Core Concept and Goals

The Boston Public Schools support the core concept of the Massachusetts Social Studies Curriculum Framework:

Social Studies education teaches students to become active, responsible participants in their communities, committed to the fundamental values and principles of democracy.

In addition, we are committed to the goals embedded in the six strands included in the state framework. Students will graduate with a strong foundation in each of the following areas:

- **History**: Students will develop a sense of chronology; they will consider people, actions, and events with a critical eye, and an understanding of historical perspective.
- **Geography**: Students will develop a geographical understanding of the world, and the relationships between the physical environment, natural resources, and the human experience.
- **Civics**: Students will gain insight into what power is and how it is legitimized through governance; they will understand the principles of democracy and other systems of governance, and their roles and responsibilities as members of a democratic society.
- **Economics**: Students will explore the important role economics plays in shaping our society; they will understand basic economic theory, the principles of capitalism and other economic systems, and the practical applications of economics in our lives as citizens, workers, and consumers.
- **Cultural Studies**: Students will learn to respect and value a diversity of cultures and to recognize the rich diversity of human experience and expression.
- **World Studies**: Students will learn that as members of the global community, it is important to know and care about what happens in other places.

Finally, we turned to the National Standards for History for guidance, and identified a set of principles of particular importance. We believe that,

- children can, from the earliest elementary grades, begin to build historical understandings and perspectives and to think historically
- history needs to be linked to related studies in geography, civics, economics, social life, religion, science and technology, literature, and the arts
- our standards need to be intellectually demanding, and promote active questioning and learning rather than passive absorption of facts, dates, and names
- our standards need to strike a balance between emphasizing broad themes and probing specific events, ideas, movements, persons, and documents

Current Conditions: Standards and Curriculum Development

The Massachusetts Social Studies Curriculum Framework will not be completed until September, 1996. Consequently, our course sequence, and the grade-level standards detailing content expectations, will not be developed until the 1996-97 school year. The standards in this document focus on the *skills* students will be expected to develop and apply to any content they may study.

In addition, this document includes those products students will be expected to complete, as a condition of grade level and course completion. Each product addresses a set of geography, history, writing, and thinking skills that are relevant to any Social Studies course.

Over the course of this summer, task descriptions will be developed, describing each student product in detail. Teachers, students, and parents may use these task descriptions as instructional tools, and as tools to help them discuss and assess students' work, as it's being developed, and when it's completed. Support will be provided to help teachers become more familiar with the products and task descriptions, to share promising instructional practices, and to help them use the task descriptions most effectively.

We also hope to collect samples of students' work on these products, from schools, on a voluntary basis, at the close of the 1996-97 school year. During the summer of 1997, this student work would be reviewed and discussed by teams of teachers citywide. This process would be designed to:

- refine the performance standards for these products....define precisely what performing at or above standard really means
- identify exemplars of student work "at standard", to be made available to teachers for additional school-based professional development activities
- refine the task descriptions used to develop and assess students' work

A Five Year Plan:

The standards we have set represent expectations we will increasingly meet over the course of next five years. By the close of this decade, students will be required to achieve these standards, as a condition of graduation.

Every school and teacher needs to begin to implement these standards, and the student products, next year. Individual schools should construct careful plans that highlight the steps they will take to reach these standards within five years, and to assess student progress on an annual basis.

Boston Public Schools: Citywide Learning Standards -DRAFT- Social Studies, Middle and High School Grades

Introduction:

The skills and understandings identified below are important to the study of history, geography and social studies in all secondary grades. They are developed to increasing degrees of sophistication throughout middle school and high school.

Every middle and high school History/Social Studies teacher should develop these skills and understandings in students. Grade level differentiation comes:

- when students apply these skills to works of increasing length and complexity,
- when students are asked to make increasingly complex and sophisticated observations, insights and assertions, and
- when students' writings and other responses are evaluated for increasing levels of proficiency and increasingly complex ideas.

Strand #1: Geography

Standard: Students understand the concepts and details of physical and political geography, and humankind's political, social, and economic relationship with the physical environment.

Students will understand...

- How to use maps and other geographical representations, tools and technology to acquire, process, and report information from a spatial perspective.
- How to use mental maps to organize information about people, places, and environments in a spatial context.
- How to use maps, photos, and personal observations to analyze the spatial organization of the world's people, places, and environments.
- The key physical and human characteristics of places around the world.
- The relationship between a region's physical and human characteristics.
- How culture, experience, and stereotype influence one's perception of places and regions.
- The characteristics, distribution, and migration of human populations.
- The characteristics, distribution, and complexity of the world's cultural groups.
- Patterns and networks of economic interdependence throughout the world.
- Patterns of human settlement, growth, and decline.
- How cooperation and conflict influence the control of land and water (and vice-versa).
- How human actions modify the environment.
- How the environment affects human systems (e.g. housing, industry).
- Changes that occur in the use, distribution, and importance of resources.
- The fundamental role geography has played in shaping historical events.
- How to use geography to interpret the present and plan for the future.

Strand #2: Chronological Thinking

Standard: Students think chronologically.

Students will.....

- Place information in a chronological sequence.
- Interpret data presented on timelines and create the same to appropriate scale.
- Reconstruct patterns of historical succession and duration, and apply them to explain historical continuity and change.

Strand #3: Comprehension

Standard: Students comprehend a variety of historical and social studies source documents and materials.

Students will:

- Identify the author or source of a document or narrative and assess its credibility.
- Reconstruct the literal meaning of a passage.
- Identify the central question in an historical or contemporary narrative.
- Differentiate between facts, interpretations, opinions, and beliefs.
- Recognize the historical context of narratives and documents.

Strand #4: Analysis and Interpretation

Standard: Students engage in historical analysis and interpretation.

Students will:

- Compare and contrast differing sets of ideas, values, personalities, behaviors, and institutions.
- Consider multiple perspectives and recognize historical and contemporary interpretations as subjective.
- Incorporate multiple causes in analyses and explanations responding to historical or contemporary questions.
- Challenge arguments of inevitability.
- Make connections between the past and the present.
- Formulate probing questions.
- Consider contextual knowledge and perspectives of the time and place, and construct a sound interpretation/thesis.
- Interpret data presented on charts and graphs, and create the same to appropriate scale.

Strand #5: Research Capabilities

Standard: Students conduct historical and social studies research.

Students will:

- Effectively identify and employ a variety of reference materials, including primary source documents and information technologies.
- Formulate appropriate research questions.

Strand #5: Research Capabilities (continued)

Standard: Students conduct historical and social studies research (continued).

Students will:

- Employ proper formats when completing research papers.
- Reference source documents liberally, to support statements and positions.
- Credit sources appropriately.
- Write properly constructed bibliographies.

Strand #6: Issues Analysis and Decision-Making

Standard: Students engage in historical and social issues analysis and decision-making.

Students will master and apply a structured process when conducting research or answering key/research questions. They will:

- Identify and clarify the key question they hope to answer.
- Identify criteria to assess emerging evidence and answers.
- Obtain information from a variety of sources, perspectives, (and eras, where appropriate).
- Evaluate the information for accuracy:
 - Evaluate sources for reliability and bias.
 - Distinguish fact from opinion, assumption, and belief.
 - Compare and evaluate competing descriptions, analyses, and interpretations.
 - Evaluate for gaps in reasoning.
 - Consider the historical context including customs, norms and values of the day; political and economic conditions; and various competing interests.
- Evaluate alternative answers, applying the criteria and the evidence.
- Formulate conclusions, identify questions that merit additional consideration, and suggest how things should have turned out differently, where appropriate.

Ninth/Tenth Grade Social Studies: Student Products

Students will successfully complete at least one of the following products during the 1996-97 school year. Teachers, working in grade level or school-wide teams, will select the product(s) all students will be required to complete.

1. **Biographical Paper:** Each student will complete a six page paper that analyzes the leadership style and decision making characteristics of two important historical or current figures (i.e. political, religious, community leaders).

Examples:

Compare the leadership style and strategies of one of the following pairs of important historical figures:

Herbert Hoover and Franklin Roosevelt

Bill Clinton and Bob Dole

Martin Luther King and Malcolm X

Objectives: In preparing, completing, and presenting the product, students will.....

- Identify and respond to key question(s) s/he will address
- Provide sufficient background information on the key question(s)
- Gather information from at least five sources, including books, periodicals, and primary source documents
- Consider multiple perspectives
- Evaluate the information (and sources) for reliability, accuracy, bias and propaganda, distinguishing fact from opinion, assumption, and belief
- Compare and evaluate competing descriptions, analyses, and interpretations
- Explain information and events in sequence
- Consider the norms, values and customs of the day, as well as the political and economic conditions etc., in drawing any conclusions
- Reach sound conclusions based on the evidence and clear criteria
- Organize the paper into proper sections and paragraphs
- Use appropriate terms
- Properly cite each source (footnotes and annotated bibliography)
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing).

2. **Position Paper:** Each student will complete a six page paper that analyzes and responds to a specific current political/social question.

Examples:

Does the current welfare system need to be abolished?

Should national service be required of all young people?

Should all political campaigns be publicly financed?

Objectives: In preparing, completing, and presenting the product, students will.....

- Identify a key issues that needs to be addressed
- Identify and respond to a key question, related to the issue, that is focused and manageable
- Gather and present sufficient background information on the issue
- Gather the information from at least five sources, including books, periodicals, and primary source documents
- Explain the issue and events in terms of their development over time, and in sequence
- Consider multiple perspectives
- Evaluate the information (and sources) for reliability, accuracy, bias and propaganda, distinguishing fact from opinion, assumption, and belief
- Compare and evaluate competing descriptions, analyses, and interpretations

Position Paper (continued)

- Make important connections between events, people, and the issue(s)
- Consider ethical concerns and the competing interests
- Reach sound conclusions based on the evidence
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

3. **Geography Report:** Each student will complete a six page geography report that makes the connections between natural resources, economic development, and one or more population centers.

Examples:

What was the connection between the following:

<i>Coal/Iron Ore</i>	<i>Steel Industry</i>	<i>Pittsburgh</i>
<i>Harbor</i>	<i>Trade</i>	<i>New York</i>
<i>Great Plains</i>	<i>Cattle Industry</i>	<i>Texas</i>
<i>Coal</i>	<i>Industrial Revolution</i>	<i>Britain</i>

Objectives: In preparing, completing, and presenting the product, students will.....

- Identify the key question s/he will answer
- Gather sufficient background information on the topic
- Gather the information from at least five sources, including books, periodicals, and primary source documents including maps, charts etc.
- Assess the credibility of the information
- Identify and accurately analyze the relationship between natural resources, economic development, and one or more population centers
- Describe the relationship between a region's physical and human characteristics
- Explain events, issues or problems in terms of their development over time
- Reach sound conclusions based on the evidence and clear criteria
- Organize the paper into proper sections and paragraphs
- Properly cite each source (footnotes and annotated bibliography)
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

4. **Debate:** Each student will participate in a debate in which the student will take the affirmative or negative argument on a current or enduring issue involving a political, social, or economic question. This product would include a 3-5 page position paper.

Examples:

Resolve: The United States should replace the current tax system with a flat tax.
The United States should replace the current medical system with a system of socialized medicine.
The public school system should be replaced by a system of vouchers.

Objectives: In preparing, completing, and presenting the product, students will.....

- Identify the key question that is being addressed
- Gather sufficient information from a variety of sources and perspectives
- Evaluate the information (and sources) for reliability, accuracy, bias and propaganda, distinguishing fact from opinion, assumption, and belief
- Compare and evaluated competing arguments, analyses, and interpretations
- Make connections between arguments and the key question
- Evaluate the ethical considerations and the interests served re: different positions
- Speculate on the influence of the issue on the future
- Reach sound conclusions based on the evidence
- Develop persuasive arguments taking the affirmative *and* negative position
- Demonstrate a satisfactory grasp of the question and related issues
- Organize note cards and prepare for the debate
- Organized the paper into proper sections and paragraphs

Debate (continued)

- Properly cited each source (footnotes and annotated bibliography)
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

Eleventh/Twelfth Grade Social Studies: Student Products

Students will successfully complete at least one of the following products during the 1996-97 school year. Teachers, working in grade level or school-wide teams, will select the product(s) all students will be required to complete.

1. **Thematic Paper:** Each student will complete an eight page paper that analyzes a question and makes connections between specific historical events (including current events) over time.

Sample Questions:

How has the United States typically responded to the arrival of new immigrants?

How has the definition of "democracy" changed during the twentieth century?

How has the status of women changed in America during the twentieth century?

Objectives: In preparing, completing, and presenting the product, students will.....

- Identify a key question they will answer that requires them to make connections between specific historical events over a period of time
 - Gather and present sufficient background information, from at least five sources, including books, periodicals, and primary source documents
 - Consider multiple perspectives
 - Explain the information and events in sequence
 - Evaluate the information (and sources) for reliability, accuracy, bias and propaganda, distinguishing fact from opinion, assumption, and belief
 - Compare and evaluate competing descriptions, analyses, and interpretations
 - Make connections between historical events, persons, and/or issues
 - Consider the events in some historical context, considering norms, values and customs of the day, as well as political and economic conditions etc.
 - Reach sound conclusions based on the evidence and clear criteria
 - Organize the paper into proper sections and paragraphs
 - Properly cited each source (footnotes and annotated bibliography)
 - Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).
2. **Research Paper:** Each student will complete an eight page paper that analyzes and responds to a specific, open-ended historical or contemporary question.

Examples:

Why do the English refer to the overthrow of James II as the "Glorious Revolution"?

Should the electoral college be abolished as a means to elect Presidents?

Should the United States military defend Taiwan if it is attacked by China?

Objectives: In preparing, completing, and presenting the product, students will.....

- Identify a key question that is interesting, focused and manageable
- Gather sufficient background information that responds to the question, from at least five sources, including books, periodicals, and primary source documents
- Consider multiple perspectives
- Evaluate the information (and sources) for reliability, accuracy, bias and propaganda, distinguishing fact from opinion, assumption, and belief
- Compare and evaluate competing descriptions, analyses, and interpretations
- Consider the question in some historical context, considering norms, values and customs of the day, as well as political and economic conditions etc.
- Consider past responses to the same or similar issues addressed in the question and make appropriate connections
- Reach sound conclusions based on the evidence and clear criteria

Research Paper (continued)

- Organize the paper into proper sections and paragraphs
- Properly cited each source (footnotes and annotated bibliography)
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

3. **Debate:** Each student will participate in a debate in which the student will take the affirmative or negative argument on a current or enduring issue involving a political, social, or economic question. This product would include a position paper.

Examples:

*Resolve: The United States should replace the current tax system with a flat tax.
The United States should replace the current medical system with a system of socialized medicine.
The public school system should be replaced by a system of vouchers.*

Objectives: In preparing, completing, and presenting the product, students will.....

- Identify the key question that is being addressed
- Gather sufficient information from a variety of sources and perspectives
- Evaluate the information (and sources) for reliability, accuracy, bias and propaganda, distinguishing fact from opinion, assumption, and belief
- Compare and evaluated competing arguments, analyses, and interpretations
- Make connections between arguments and the key question
- Evaluate the ethical considerations and the interests served re: different positions
- Speculate on the influence of the issue on the future
- Reach sound conclusions based on the evidence
- Develop persuasive arguments taking the affirmative *and* negative position
- Demonstrate a satisfactory grasp of the question and related issues
- Organize note cards and prepare for the debate
- Organized the paper into proper sections and paragraphs
- Properly cited each source (footnotes and annotated bibliography)
- Use appropriate language, conventions, and presentation techniques (see English Language Arts standards: Writing; Listening, Speaking, and Presenting).

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